VNIVERSITAT DE VALÈNCIA

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Programa de Doctorat en Psicologia i Psicopatologia Perinatal i Infantil

Tesi Doctoral

"Les habilitats de comunicació social primerenca i la seua relació amb la competència lingüística i amb la presència de marcadors de risc d'autisme: estudi longitudinal dels 8 als 18 mesos d'edat"

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TÍTULO EN CASTELLANO: *"Las habilidades de comunicación social temprana y su relación con la competencia lingüística y con la presencia de marcadores de riesgo de autismo: estudio longitudinal de los 8 a los 18 meses de edad"*

TITLE IN ENGLISH: *"Early social communication abilities and their relationship with linguistic competence, and with the presence of autism risk markers: A longitudinal study from 8 to 18 months of age"*

"*Understanding joint attention will not completely explain autism, but it is very likely that no explanation of autism will be complete without a definitive understanding of joint attention's role in its ethology*" (Mundy, 2016, p. IX, Preface).

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RESUM

Des del naixement, els bebès mostren una atracció natural per les cares humanes (Bedford et al., 2012; Droucker, Curtin, & Vouloumanos, 2013). Així mateix, des dels primers mesos de vida, manifesten un fort interès per mirar cap a la direcció que indica la mirada de l'adult (Farroni, Massaccesi, Menon, & Johnson, 2004). Al voltant dels 6-8 mesos, aprenen a alinear deliberadament la seua pròpia mirada amb la mirada de l'adult (Beuker, Rommelse, Donders, & Buitelaar, 2013). Més tard, passen de seguir la direcció de la mirada de l'adult als 6 mesos a comprendre la intencionalitat d'aquesta mirada al voltant dels 12 mesos (Tomasello, Carpenter, Call, & Behne, 2005). Amb la comprensió del significat d'aquesta mirada apareix l'atenció conjunta.

L'atenció conjunta és l'habilitat de coordinar l'atenció per adoptar un punt de referència comú amb una altra persona. Aquest punt de referència comú sol ser un objecte o un esdeveniment d'interès (Mundy & Newell, 2007; Salo, Rowe, & Reeb-Sutherland, 2018; Scaife & Bruner, 1975). És un clar indicador de comprensió de les representacions dels altres (Brooks & Meltzoff, 2005), i té un paper important en l'aparició del pensament simbòlic i en el desenvolupament del llenguatge (Jones et al., 2009; Salo et al., 2018). Aquesta habilitat té, principalment, una funcionalitat declarativa, quan s'usa per a compartir motivacions i interessos amb els altres, però

també pot tenir un ús instrumental-imperatiu, quan s'empra per a aconseguir un objecte o un objectiu (Mundy et al., 2007; Salo et al., 2018). Tradicionalment, s'ha utilitzat el terme d'*atenció conjunta* per a referir-se a l'ús declaratiu d'aquesta conducta comunicativa, i se sol utilitzar el terme de *conducta de demanda* per a referir-se al seu ús instrumental-imperatiu (Mundy et al., 2003; Seibert, Hogan, & Mundy, 1982).

Aquestes dues dimensions de l'atenció compartida formen part del que anomenem "habilitats de la comunicació social primerenca". A més a més, hem d'incloure també una tercera dimensió: la *interacció social*. La interacció social es refereix a aquelles conductes en què l'infant i el cuidador participen en activitats lúdiques, d'afectivitat positiva i reciprocitat (Harrist & Waugh, 2002). Pot comportar l'ús d'objectes, però la referència a l'objecte no és una característica principal. Alguns exemples són fer-se pessigolles o jugar a passar-se una pilota per torns (Mundy et al., 2003). Les conductes d'atenció conjunta i de conducta de demanda són de naturalesa triàdica, vist que típicament intervenen dos interlocutors i un objecte. D'altra banda, la conducta d'interacció social té un caràcter diàdic, perquè sol donar-se entre dues persones i sense la necessitat que hi haja també un tercer element. Així, parlaríem de tres dimensions en la comunicació social primerenca: (1) l'atenció conjunta, (2) la conducta de demanda i (3) la interacció social. Els dèficits en aquestes habilitats, especialment les dificultats en atenció conjunta, són un dels marcadors més clars de signes primerencs del

trastorn de l'espectre autista (TEA) (Curcio, 1978; Ibáñez, Grantz, & Messinger, 2013; Macari et al., 2012; Mundy et al., 2007; Mundy, 2016; Schertz, Odom, Baggett, & Sideris, 2018; Thorup et al., 2018).

L'objectiu del present treball ha estat avaluar les habilitats de la comunicació social primerenca en una mostra de xiquets nascuts a la província de València en tres moments evolutius (8, 12 i 18 mesos), per tal d'explorar si aquestes habilitats en els moments evolutius més primerencs es relacionen amb les habilitats del llenguatge en els posteriors moments evolutius, i amb la presència de signes primerencs de TEA als 12 mesos i als 18 mesos d'edat. Es tracta d'un estudi de cohort longitudinal prospectiu amb tres moments d'avaluació: 8 mesos, 12 mesos i 18 mesos. La mostra ha estat formada per 55 bebès nascuts a la província de València i les seues famílies: 24 xiquets (43.6%) i 31 xiquetes (56.4%). Als 8 mesos s'avaluaren 52 xiquets, als 12 mesos s'avaluaren 45 xiquets i als 18 mesos s'avaluaren 30 xiquets. La majoria d'aquests participants en cada moment són el mateix xiquet que ha estat avaluat en els tres moments. En alguns casos, són xiquets que han estat avaluats als 8 i als 12 mesos, mentre que en altres casos ho han estat als 8 i als 18 mesos. Una minoria de xiquets participants han estat avaluats només als 8 mesos. El reclutament de la mostra es realitzà amb la col·laboració de diversos professionals vinculats a Centres de Salut i Hospitals de la ciutat de València.

L'instrument que s'ha emprat per avaluar les habilitats de comunicació social primerenca és l'*Early Social-Communication Scales*

(ESCS) (Mundy et al., 2003). Les variables avaluades amb aquest instrument han estat: l'inici d'atenció conjunta de baix nivell (IJAL), l'inici d'atenció conjunta d'alt nivell (IJAH), la resposta d'atenció conjunta proximal (RJAP), la resposta d'atenció conjunta distal (RJAD), l'inici de conducta de demanda de baix nivell (IBRL), l'inici de conducta de demanda d'alt nivell (IBRH), la resposta de conducta de demanda total (RBRT), l'inici d'interacció social (ISI), i la resposta d'interacció social total (RSIT). Les variables de baix nivell fan referència a les conductes comunicatives de contacte ocular i d'alternança de mirada, mentre que les variables d'alt nivell fan referència a conductes comunicatives de tipus gestuals (assenyalar, donar o mostrar). Quan una variable és d'inici, significa que és el xiquet qui inicia l'episodi. Quan una variable és de resposta, significa que el xiquet respon a una invitació que fa l'adult. L'etiqueta de proximal significa que l'objecte de referència està a una distància a l'abast del xiquet (per exemple, unes imatges a un llibre). L'etiqueta de distal significa que l'objecte de referència està relativament lluny (per exemple, un pòster en una paret).

La competència lingüística s'ha avaluat amb els *Inventarios de Desarrollo Comunicativo MacArthur* (MCDI) (Jackson-Maldonado et al., 2003), adaptació espanyola de López Ornat et al. (2005). Les variables de competència lingüística que s'han avaluat als 12 mesos són: vocalitzacions (VOC12), comprensió de paraules (WC12), producció de paraules (WP12), i gestos i accions (GA12). Les variables de

competència lingüística que s'han avaluat als 18 mesos són: vocalitzacions (VOC18), producció de paraules (WP18), acabament de paraules (WEND18), i complexitat morfosintàctica (MSYC18).

Els primers marcadors de simptomatologia TEA s'han avaluat emprant el *First Year Inventory* (FYI) (Baranek, Watson, Crais, & Reznic, 2003) als 12 mesos, i el *Cuestionario de Autismo en la Infancia-Modificado* (M-CHAT) (Robins, Fein, Barton, & Green, 2001) als 18 mesos. Als 12 mesos, la presència de signes de TEA ve marcada per la puntuació a l'instrument FYI. A major puntuació, major presència de simptomatologia primerenca. Als 18 mesos, el risc de TEA ve marcat per la presència/absència de marcadors, que s'obtè a partir de l'aplicació de l'instrument M-CHAT (Robins et al., 2001).

Per a l'anàlisi de dades s'ha emprant el programa d'anàlisi estadística SPSS, versió 24.0 (Cor, 2016). S'han realitzat anàlisis descriptives, així com anàlisis correlacionals, MANOVA, regressions lineals múltiples i regressions logístiques.

Els resultats mostraren correlacions estadísticament significatives entre algunes de les mesures de comunicació social primerenca en cada moment: als 8, als 12 i als 18 mesos. Les correlacions significatives més destacades foren les següents. IJAL i IJAH mostraren una correlació estadísticament significativa: correlacionaren positivament als 8 mesos i negativament als 12 mesos. IJAL i IBRL correlacionaren significativament als 8 mesos, mentre que les seues anàlogues d'alt

nivell (IJAH i IBRH) correlacionaren significativament als 12 mesos. IJAL i RJAP correlacionaren significativament als 8 i als 18 mesos. RJAP i RJAD correlacionaren significativament als 8 i als 12 mesos d'edat. Finalment, ISI i RSIT correlacionaren significativament als 8 mesos.

Quant a l'evolució de les variables de la comunicació social primerenca, els resultats indicaren que aquestes variables tenen moments d'emergència i d'evolució distints. IJAL i RJAP són conductes que sorgeixen de forma primerenca. És per això que el seu patró de creixement va ser pla, amb puntuacions mitjanes que es mantingueren altes al llarg dels tres moments. Les diferències entre els moments no van ser significatives per a IJAL (8-12 mesos, 12-18 mesos i 8-18 mesos). Pel que fa a RJAP, només les diferències entre els 12 i els 18 mesos van ser significatives. IBRL presentava un ascens dels 8 als 12 mesos d'edat i una lleugera disminució dels 12 als 18 mesos. Les diferències entre els moments van ser significatives en tots els casos per a IBRL (8-12 mesos, 12-18 mesos i 8-18 mesos). IJAH, RJAD, IBRH i RBRT van presentar un patró generalment creixent, amb una puntuació mitjana zero als 8 mesos i un ascens dels 8 als 12 mesos i dels 12 als 18 mesos. Les diferències entre els moments van ser significatives en tots els casos per a aquestes variables (8-12 mesos, 12-18 mesos i 8-18 mesos). ISI i RSIT mostraren un punt de partida baix als 8 mesos, un augment dels 8 als 12 mesos i un patró pla dels 12 als 18 mesos. Les diferències van ser significatives entre els 8 i els 12 mesos i entre els 8 i els 18 mesos per a les variables ISI i RSIT.

Pel que fa a la relació entre la comunicació social primerenca i els primers signes de TEA, cap mesura dels 8 mesos fou significativa a l'hora de predir la simptomatologia precoç de TEA als 12 mesos. No obstant això, els primers signes de TEA als 18 mesos pogueren predir-se amb les mesures d'IJA i d'ISI als 8 mesos, i amb les mesures de RJA als 12 mesos.

Per últim, els resultats van revelar que les mesures de RJAD als 8 mesos podien predir significativament la comprensió de paraules als 12 mesos, mentre que les mesures de RJAD als 12 mesos podien predir significativament la conducta de vocalització als 18 mesos.

En síntesi, sembla que les dificultats d'atenció conjunta als 8 i als 12 mesos són un bon indicador de la presència de primers signes de TEA als 18 mesos. Als 8 mesos, les conductes que més informen sobre aquesta primera simptomatologia són les conductes d'inici d'atenció conjunta, mentre que als 12 mesos són les conductes de resposta d'atenció conjunta. Quant a la competència lingüística, la resposta d'atenció conjunta distal és una conducta comunicativa pre-verbal que es relaciona significativament amb la competència lingüística posterior: amb el volum de vocabulari als 12 mesos i amb la conducta de vocalització als 18 mesos.

Aquesta és una investigació que pot contribuir a una millor comprensió del paper de la comunicació social primerenca en el desenvolupament del llenguatge i en la detecció primerenca del TEA.

Pot ser una aportació per a futures investigacions més centrades en la detecció i la intervenció precoç. La intervenció primerenca és d'especial interès perquè, fins i tot sense confirmació del diagnòstic, permet el treball de les habilitats socials amb xiquets en risc (Dawson et al., 2010; Johnson, 2008; Kasari, Gulsrud, Freeman, Paparella, & Hellemann, 2012; Kasari, Gulsrud, Wong, Kwon, & Locke, 2010; Reichow & Wolery, 2009; Rogers & Dawson, 2010; Twyman, Maxim, Leet, & Ultman, 2009; Zwaigenbaum, Bryson, & Garon, 2013). A més a més, es produeix durant una etapa del desenvolupament infantil on el cervell gaudeix de major plasticitat, afavorint la generació de canvis permanents en la seua fisiologia (Dawson, 2008; Zwaigenbaum et al., 2013).

ABSTRACT

Babies show a natural attraction for human faces since birth (Bedford et al., 2012; Droucker et al., 2013). Likewise, from the first months of life, they show a strong interest in looking at the direction that the adult's gaze indicates (Farroni et al., 2004). At about 6-8 months old, they learn to deliberately align their own gaze with the adult's gaze (Beuker et al., 2013). Then, children go from following the direction of the adult's gaze at 6 months old to understanding the intention of this gaze around 12 months of age (Tomasello et al., 2005). With the understanding of the meaning of this gaze, joint attention emerges.

Joint attention is the ability to coordinate the attention to adopt a common point of reference with another person. This common point of reference is usually an object or an event of interest (Mundy & Newell, 2007; Salo et al., 2018; Scaife & Bruner, 1975). It is a clear indicator of the comprehension of others' representations (Brooks & Meltzoff, 2005), and it plays an important role in the emergence of symbolic thinking and language (Jones et al., 2009; Salo et al., 2018). Joint attention has mainly a declaratory functionality, when used to share motivations and interests with others. But it can also have an instrumental-imperative use, when used to achieve an object or an objective (Mundy et al., 2007; Salo et al., 2018). Traditionally, the term *joint attention* has been used to refer to the declarative use of this

communicative behaviour, whereas the term *behavioural request* is often used to refer to its instrumental-imperative use (Mundy et al., 2003; Seibert et al., 1982).

These two dimensions of shared attention are part of what we call "early social communication abilities". In addition to that, we must also include a third dimension: *social interaction*. Social interaction refers to those behaviours in which the child and the caregiver participate in recreational, of positive affectivity and reciprocity activities (Harrist & Waugh, 2002). It may involve the use of an object, but the reference to the object is not the main feature. Some examples of social interaction are tickling or turn-taking games (Mundy et al., 2003). Joint attention and behavioural request are of a triadic nature, given that typically two interlocutors and an object are involved. On the other hand, social interaction has a dyadic character, because it usually occurs between two people without the need to involve a third element. Thus, we would talk about three dimensions in early social communication: (1) joint attention, (2) behavioural request, and (3) social interaction. Deficits in these abilities, especially difficulties in joint attention, are one of the strongest markers of early signs of autism spectrum disorder (ASD) (Curcio, 1978; Ibáñez et al., 2013; Macari et al., 2012; Mundy et al., 2007; Mundy, 2016; Schertz et al., 2018; Thorup et al., 2018).

The objective of this study was to evaluate early social communication in a sample of children born in the province of València, in three evolutionary moments (8, 12 and 18 months). These

evaluations were conducted to explore if these early abilities are related to subsequent language skills, and with the presence of ASD early markers at 12 and 18 months of age. This is a prospective longitudinal cohort study with three evaluation moments: 8 months, 12 months and 18 months. The sample was formed of 55 babies born in the province of València and their families: 24 boys (43.6%) and 31 girls (56.4%). At 8 months, 52 children were assessed. At 12 months, 45 children were assessed. At 18 months, 30 children were assessed. Most of these participants at each moment are the same child who was evaluated in all three moments. In some cases, children were evaluated at 8 and 12 months old. In other cases, they were assessed at 8 and 18 months old. A minority of participating children were evaluated only at 8 months old. The recruitment of the sample was carried out with the collaboration of several professionals linked to different Health Centres and Hospitals of the city of València.

The instrument used to evaluate early social communication skills was the *Early Social-Communication Scales* (ESCS) (Mundy et al., 2003). The variables evaluated with this instrument were: lower-level of initiating joint attention (IJAL), higher-level of initiating joint attention (IJAH), responding to proximal joint attention (RJAP), responding to distal joint attention (RJAD), lower-level of initiating behavioural request (IBRL), higher-level of initiating behavioural request (IBRH), responding to behavioural request - total (RBRT), initiating social interaction (ISI), and responding to social interaction - total (RSIT).

Lower-level variables refer to communicative behaviours of eye contact and gaze alternation. *Higher-level* variables refer to gestural communicative behaviours, such as pointing, giving, and showing. When a variable is an *initiating* variable, that means that it is the child who starts the episode. When a variable is a *response* variable, that means that the child is responding to an invitation made by the adult. When a variable is *proximal*, that means that the reference object is at a distance within reach of the child (for example, images in a book). When a variable is *distal*, that means that the reference object is relatively far (for example, a poster on a wall).

Linguistic competence was evaluated with the *MacArthur Communicative Development Inventories* (MCDI) (Jackson-Maldonado et al., 2003), Spanish adaptation of López Ornat et al. (2005). The linguistic competence variables evaluated at 12 months were: vocalizations (VOC12), word comprehension (WC12), word production (WP12), and gestures and actions (GA12). The linguistic competence variables evaluated at 18 months were: vocalizations (VOC18), word production (WP18), word ending (WEND18), and morphosyntactic complexity (MSYC18).

Early markers of ASD symptomatology were evaluated using the *First Year Inventory (FYI)* (Baranek et al., 2003) at 12 months old, and the *Cuestionario de Autismo en la Infancia-Modificado* (M-CHAT) (Robins et al., 2001) at 18 months old. At 12 months, the presence of ASD early signs was determined by the score obtained with the FYI. A

higher score was indicating a greater presence of early symptomatology. At 18 months, ASD early symptomatology was determined by the presence/absence of early markers, obtained from the application of the M-CHAT (Robins et al., 2001).

Data analysis was performed using the statistical analysis program SPSS, version 24.0 (Cor, 2016). Descriptive analyses, correlational analyses, MANOVA, multiple linear regressions and logistic regressions were conducted.

The results showed statistically significant correlations between some of the early social communication measures at 8, at 12 and at 18 months. The most noteworthy significant correlations were the following. IJAL and IJAH showed a statistically significant correlation: they correlated positively at 8 months and negatively at 12 months. IJAL and IBRL correlated significantly at 8 months, while their higher-level analogues (IJAH and IBRH) correlated significantly at 12 months. IJAL and RJAP correlated significantly at 8 and 18 months. RJAP and RJAD correlated significantly at 8 and 12 months of age. Finally, ISI and RSIT correlated significantly at 8 months.

Regarding the evolution of the early social communication variables, the results indicated that they present different onsets and different growth patterns. IJAL and RJAP are behaviours with an early onset. That is why their growth pattern was flat, with average scores that remained high throughout the three moments. The differences between the moments were not significant for IJAL (8-12 months, 12-

18 months and 8-18 months). Regarding RJAP, only the differences between 12 and 18 months were significant. IBRL presented an increase from 8 to 12 months, and a slight decrease from 12 to 18 months. The differences between the moments were significant in all cases for IBRL (8-12 months, 12-18 months and 8-18 months). IJAH, RJAD, IBRD and RBRT presented a generally growing pattern: a zero-average score at 8 months, and an increase between 8 and 12 months and between 12 and 18 months. The differences between the moments were significant in all cases for these variables (8-12 months, 12-18 months and 8-18 months). ISI and RSIT showed a low starting point at 8 months, an increase from 8 to 12 months and a flat pattern from 12 to 18 months. The differences were significant between 8 and 12 months and between 8 and 18 months for ISI and RSIT.

Regarding the relationship between early social communication and early ASD signs, the results showed that no measures at 8 months old could significantly predict ASD early symptomatology at 12 months old. However, ASD early markers at 18 months were predicted by IJA and ISI measures at 8 months, and by RJA measures at 12 months.

Finally, the results revealed that RJAD measures at 8 months could significantly predict word comprehension at 12 months, while RJAD measures at 12 months could significantly predict vocalization behaviours at 18 months.

In summary, it seems that difficulties of joint attention at 8 and 12 months old can be an indicator of the presence of early ASD signs at 18

months. At 8 months, the variables that most informed about this early symptomatology were the initiating joint attention variables. At 12 months, the variables that most informed about this early symptomatology were the responding joint attention variables. With respect to linguistic competence, responding to distal joint attention showed to be one preverbal communication behaviour significantly related to subsequent linguistic competence. It was related to vocabulary at 12 months old, and to vocalization behaviours at 18 months old.

This is an investigation that can contribute to a better understanding of the role of early social communication in language development and early detection of ASD. It can be a contribution for future research focused on early detection and intervention. Early intervention is of special interest because, even without confirmation of the diagnosis, it allows the training of social skills with children at risk (Dawson et al., 2010; Johnson, 2008; Kasari et al., 2010, 2012; Reichow & Wolery, 2009; Rogers & Dawson, 2010; Twyman et al., 2009; Zwaigenbaum et al., 2013). In addition to that, it occurs in a stage during childhood development where the brain enjoys greater plasticity, favouring the generation of permanent changes in its physiology (Dawson, 2008; Zwaigenbaum et al., 2013).

GLOSSARY

ENGLISH

ASD: autistic spectrum disorder

BAP: broader autism phenotype

MCDI: Communicative Development Inventories

DD: developmental delay

DT: standard deviation (VAL: *desviació típica*)

EC: eye contact

ESC: early social communication

ESCS: Early Social Communication Scales

FYI: First Year Inventory

GA: gestures and actions

IBR: initiating behavioural request

IBRH: initiating behavioural request – higher

IBRL: initiating behavioural request – lower

IJA: initiating joint attention

IJAH: initiating joint attention – higher

IJAL: initiating joint attention – lower

ISI: initiating social interaction

M: arithmetic mean

M-CHAT: Modified Checklist for Autism in Toddlers – Revised

MSYC: morphosyntactic complexity

PDPM: parallel and distributed processing model

RBR: responding to behavioural request

RBRT: responding to behavioural request – total

RBRW: responding to behavioural request with gesture

RBRWO: responding to behavioural request without gesture

RISK12: ASD early markers (12 months)

RISK18: ASD early markers (18 months)

RJA: responding to joint attention

RJAD: responding to distal joint attention

RJAP: responding to proximal joint attention

RSI: responding to social interaction

RSIH: responding to social interaction – higher

RSIL: responding to social interaction – lower

RSIT: responding to social interaction – total

sib-ASD: sibling of a child with ASD

TD: typical development

ToM: Theory of Mind

VAL: Valencian language

VOC: vocalizations

WC: word comprehension

WEND: word ending

WP: word production

GLOSSARY

VALENCIÀ

AT: a terme

ATL: a terme límit

CO: contacte ocular

ESCS: Early Social Communication Scales

FYI: First Year Inventory

GA: *gestures and actions*/gestos i accions

GEG: gran per a edat gestacional

MCDI: Inventaris de Desenvolupament Comunicatiu

IJA: *initiating joint attention*/inici d'atenció conjunta

ISI: *initiating social interaction*/inici d'interacció social

LME: longitud mitjana de l'enunciat

M: mitjana aritmètica

M-CHAT: Cuestionario de autismo en la infancia-modificado

MP: molt prematurs

MSYC: *morphosyntactic complexity*

PE: prematurs extrems

PEG: petit per a edat gestacional

post-T: post-terme

PTM: prematurs tardans o moderats

RBRW: *responding to behavioural request with gesture*/resposta a la demanda amb gest

RBRWO: *responding to behavioural request without gesture*/resposta a la demanda sense gest

RISK12: marcadors primerencs de TEA

RISK18: marcadors primerencs de TEA

RJA: *responding to joint attention*/resposta d'atenció conjunta

RJAD: *responding to distal joint attention*/resposta a l'atenció conjunta distal distal

RJAP: *responding to proximal joint attention*/resposta a l'atenció conjunta proximal

RSI: *responding to social interaction*/resposta a la interacció social

sib-ASD: *sibling of a child with ASD*/germà d'un xiquet amb TEA

TEA: trastorn de l'espectre autista

VOC: vocalitzacions

WC: *word comprehension*/comprensió de paraules

WEND: *word ending*/acabament de paraules

WP: *word production*/producció de paraules

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GENERAL INTRODUCTION

The number of scientists that have decided to expand their research about autistic spectrum disorder (ASD) has boosted considerably in the past years (Dawson, 2013; Matson & LoVullo, 2009; Singh, Illes, Lazzeroni, & Hallmayer, 2009). In the following years after ASD was first mentioned in the 70s, around 4,577 papers and 495 books were printed, and in the last decades (from 1990 to 2016) approximately 39,822 and 5,875 books have been published (Mundy, 2016). The number of funded projects in the US related to ASD topics significantly increased 15% each year from 1997 to 2006 (Singh et al., 2009). Matson and LoVullo (2009) identified 16,069 articles on autism from 2008 to 1978 in their recent work (see figure *1*).

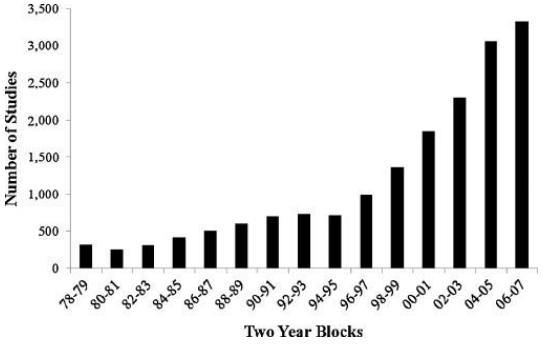

Figure 1. Number of studies published in 2-years blocks from 1978 to 2007 about ASD. Recovered from Matson & LoVullo (2009, p.254).

This increase in research has allowed new perspectives on autism to emerge, which are now coming from multiple disciplines — Medicine, Developmental Psychology and Education— and different hypotheses have been contrasted, validated, tinged, and disproved. All

this research has enriched our knowledge about ASD, its genetic and neurodevelopmental factors, early identification, diagnosis, and treatment (Dawson, 2013). However, this enlargement in studies and findings brings remarkable advantages as it brings some drawbacks. The diversity of approaches that we have now responding to the many inquiries which still surround ASD is the palpable consequence of this phenomenon. There is evidence consensus over the idea that autism is of a biological origin and it is characterized by impairments in social interactions and communication (Matson & LoVullo, 2009; Singzig, Morsch, Bruning, Schmidt, & Lehmkuhl, 2008), but we still have grave difficulties in organizing the conclusions coming from these different researches and finding a common picture of autism, its symptoms and its complex development (Dawson, 2013; Mundy, 2016).

Even when we talk about autism, we can never talk about *one* autism. According to many authors, it would be more accurate to talk about *autisms* (Geschwind & Levitt, 2007; Mundy, 2016). The social-behavioural phenotype of people with autism varies significantly across individuals and that is why we use the term *spectrum* to refer to this condition (Wing & Gould, 1979). The manifestations of ASD occur due to the combination of specific features of the disorder interacting with other developmental dimensions and other natural human factors. This idea is captured on the *Moderator Model* or *Modifier Model* of autism, which states that ASD develops from the interaction of syndrome-specific and non-syndrome-specific determinants (Burnette et al.,

2011; Mundy et al., 2007) and that interaction contributes to the heterogeneity of the ASD phenotype (Georgiades, Szatmari, & Boyle, 2013; Lenroot & Yeung, 2013; Lombardo et al., 2016; Mundy, 2019). Just like it occurs with any human dimension, categories can have fuzzy boundaries. It is not extraordinary that categories in autism may appear blurry too (Volkmar, State, & Klin, 2009). But categories in autism are not the only human categories with blurry margins. Indeed, all human categories, clinical and nonclinical, must deal with this circumstance of having to delimitate categories where borders are difficult to draw (Jablensky, 2005; Mundy, 2016). Autism is part of the human nature and human nature is irregular (Mundy, 2016).

Additionally to this phenotypic heterogeneity, we still have not been able to draw the full representation of how the different characteristics and manifestations of ASD evolve through development. We have yet to build a deeper understanding of what we can call the *developmental phenotype* of ASD (Lord, Bishop, & Anderson, 2015; Mundy, 2016), because what can be a core characteristic of autism during infancy —for instance, language impairments or difficulties in imaginative play— or during early adolescence —for example, failure to form age-appropriate peer relationships— can be irrelevant in early ages, since toddlers have not displayed these difficulties yet (Johnson, 2008); and what may be crucial to identify early signs of autism during toddlerhood —for instance, fewer use of communicative gestures— may lose significant strength when classifying this behaviour as a

feature for ASD in older children (Mundy, 2016). Hence, certain behaviours can be either stronger markers or more irrelevant signs for the diagnostic of ASD depending on the developmental context in which they appear. In addition to that, autistic manifestations can also vary because they can evolve through development and they may take a different shape as the child gets older (Mundy, 2016; Pellicano, 2010).

In sum, all this increase of research in the area —which means diversity regarding different approaches and new perspectives (Dawson, 2013)—, added to the inherent characteristic of ASD —its heterogeneity in its manifestations and changing nature as the individual grows (Georgiades et al., 2013; Lenroot & Yeung, 2013; Lombardo et al., 2016; Mundy, 2019). —, have led to the challenge of having to reach a consensus on which features are central or essential to ASD (Zwaigenbaum et al., 2013). Adopting this defiance, some authors have suggested that **impairments in non-verbal social communication**, and especially *joint attention* —understood to mean the ability of sharing a common focus and adopt a mutual point of reference with others (Mundy, Sullivan, & Mastergeorge, 2009; Scaife & Bruner, 1975)— is **one of the strongest constants in ASD behavioural phenotype** (Lee & Schertz, 2019; Mundy, 2016). Are non-verbal social communication abilities really considered when realizing the diagnosis of ASD? What exactly are we talking about when we talk about non-verbal social communication abilities? What role do they play in child development and why are they so important in ASD development? If

knowing about the non-verbal social communication impairments is essential to understand the social difficulties in autism and to realize the diagnosis, could evaluating these abilities early in life be early markers for the disorder? Why is early diagnosis and early intervention so important in ASD?

A few general notes:

(1) We will primarily focus on the visual modality when talking about joint attention. However, note that joint attention can also apply to the other sensory modalities (visual, tactile, auditory, olfactory, and gustatory) (Bigelow, 2003).

(2) Pictures will be used to illustrate some of the communicative behaviours included as variables in this study. These images were captured from the video record of the data collection sessions conducted for this same investigation. They have been altered to hinder the recognition of the child and the caregiver, yet maintaining the quality necessary to properly see the behaviour.

(3) Throughout this manuscript, the child will be referred to as a male. However, it should be known that we are talking indistinctively about a boy or a girl. Similarly, male forms will be used to refer to the caregiver. We will be referring indistinctively to a male or female caregiver.

(4) This thesis will be proposed to receive an International Mention. Therefore, part of it will be written in English and part in Valencian language.

PART I: THEORETICAL REVISION

CHAPTER 1: The role of non-verbal social communication in the diagnosis of autism spectrum disorder.

The first mention to the assessment of non-verbal social communication abilities as part of the evaluation for the identification of ASD in a diagnostic manual was in 1980 with the release of the DSM-III (American Psychiatric Association, 1980). This manual incorporated the classical conception that individuals with autism do not show *any* kind of social communicative behaviour (Verhoeff, 2013) and this idea was captured in the following phrase included in this same manual "pervasive lack of responsiveness to other people". This idea of absence of social response was debunked in the DSM-III-R (American Psychiatric Association, 1987) after research showed that it was not a matter of individuals with autism being none responsive to social interaction at all. Contrary to this classical belief, individuals with ASD would indeed participate in social situations but their responses were misfit or awkward (Wing & Gould, 1979). Sometimes, they would be willing to participate only in certain situations, given certain structured conditions which make the situation more predictable (Sato, Uono,

Okada, & Toichi, 2010). Knowing this, we can never be reliant solely on the absence/presence of social response to emit the diagnosis, but we should consider the nature of this social response, the timing, the intensity, and the durations (Falck-Ytter, Thorup, & Bölte, 2014; Franchini et al., 2019). This idea will be covered to a greater extent in Chapter 4 of this work.

Thus, the DSM-III-R (American Psychiatric Association, 1987) modified its definitions and included new utterances such as "markedly abnormal nonverbal communication […], or gestures to initiate or modulate social interaction". In this third revised edition we begin to see some clearer references to non-verbal social communication impairments, although it is with the publication of the DSM-IV (American Psychiatric Association, 1994) and the DSM-IV-TR (American Psychiatric Association, 2000) that we see more evidently the presence of *joint attention* in the description of the difficulties in communication and social interaction in autism. The following definition can be read in the DSM-IV-TR (American Psychiatric Association, 2000): "lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (by a lack of showing, bringing, or pointing out object of interest)". This segment of the revised version of the fourth manual has a direct reference to the definition of joint attention.

In actuality, with the DSM-5 (American Psychiatric Association, 2013), we keep finding sentences particularly referring to *joint attention,* which include "failure to initiate or respond to social

interaction", or "abnormalities in understanding and use of gestures, […] and nonverbal communication". Besides, it is with the DSM-5 (American Psychiatric Association, 2013) that we find explicit use of the term with definitions such as "impaired joint attention manifested by a lack of pointing, showing, or bringing objects to share interest with others, or failure to follow someone's pointing or eye gaze" (American Psychiatric Association, 2013, p. 54).

With regard to the instruments most used to realize the diagnosis, we must mention how some of these very well-known and broadly used instruments include —to a greater or lesser extent— the assessment of *joint attention* to establish the diagnosis. The element of joint attention was included as a pivotal dimension in the Autism Diagnostic Interview-Revised (ADI-R) (Lord, Rutter, & Le Couter, 1990) when it was first released by the early 1990s. The Autism Diagnostic Observation Schedule - Revised (ADOS-2) (Gotham, Risi, Pickles, & Lord, 2007) has adopted the terms *initiating joint attention* (IJA) and *responding to joint attention* (RJA) in its system and includes them in Module 1 and 2: "unusual eye contact", "RJA", "gestures", "pointing", "showing", "IJA". These two measures have become the standard most used measures for autism assessment and their high sensitivity is considered remarkable due to its very low rate of missed cases, this is, of false negatives (Franchini et al., 2019; Mundy, 2016). Likewise, its high sensitivity to discriminately identify children with ASD and children with

other developmental disorders (DD) has also been remarked (Mundy, 2016; Ventola et al., 2007).

As we can see, there is a considerable consensus among the idea that impairments in non-verbal social communication, and especially impairments in joint attention, are a significant feature to better comprehend autism syndrome development and establish the diagnosis (Adamson, Bakeman, Suma, & Robins, 2019; Lee & Schertz, 2019; Mundy, 2016; Thorup et al., 2018). However, studies do not always agree on *why* individuals with ASD display these difficulties (Mundy, 2016). Different approaches have tried to give response to this question. Joint attention, defined as the ability to share attention with others (Mundy et al., 2009; Scaife & Bruner, 1975), requires the use and management of skills like attention shifting and attention maintaining. It seems reasonable that people with ASD may have difficulties in coping with these attention requirements (Elison et al., 2013; Elsabbagh et al., 2013; Zwaigenbaum et al., 2005). Joint attention requires that the individual focus initially on an object and then switch attention to another person to share interest and then shift again to return the attention to the object. In order to acquire this milestone, cognitive control and the use of some inhibition is needed. These features are part or what it is known as *executive functions,* and deficits in executive functions are one of the characteristics that can explain part of the ASD symptomatology (Craig et al., 2016; Hill, 2004; Schmitz et al., 2006). Thereby, difficulties in inhibition control and attention

management could be one of the elements behind the difficulties in joint attention (Elison et al., 2013; Elsabbagh et al., 2013; Zwaigenbaum et al., 2005).

But difficulties in joint attention may not always be necessarily due to problems with managing attention —that would be more typical of individuals with attention-deficit/hyperactivity disorder (ADHD) or individuals with comorbidity of ASD and ADHD— (Mundy, 2016). Rather, it has been hypothesised that these altered patterns of joint attention that individuals with ASD display may come because social episodes are not always rewarding for them (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). Children with ASD tend to have moderate or intermittent motivation for joint attention, and that could be due to social interaction not being as pleasant or as appealing as, for example, object exploration (Chevallier et al., 2012; Kim et al., 2014; Lee & Schertz, 2019; McCleery, Akshoomoff, Dobkins, & Carver, 2009; Moriuchi, Klin, & Johnes, 2016).

Other authors study these difficulties in early social communication (ESC) by talking about the difficulties that individuals with autism have when processing self-referenced information. If we review the definition of joint attention, we see that it requires the person to attend to information about oneself, information about the other person, and information about an object (Adamson, 1995; Johnson, 2008; Mundy, 2016). This idea about a three-way processing will be covered in greater extent in Chapter 2, section 2. 1. Therefore,

and according to this approach, joint attention difficulties would not lie on the lack of (or mild) motivation for social interaction, but on difficulties in self-referenced-information processing. Along the same lines, other authors claim that the real struggle from them is the combination of self-referenced-information processing with processing the other-person information, while processing the information about the external object. These authors suggest that joint attention impairments reside in the difficulty of coordinating and integrating this three-sources processing (Mundy, 2016). Having to deal with information of different nature requires the role of short-term memory and working memory, and that is something in which children with autism may have problems (Cowan et al., 2005).

In summary, professionals and researchers still struggle with the idea of why individuals with autism display impairments in non-verbal social communication. Nevertheless, the consensus is strong when it comes to the fact that non-verbal social communication difficulties, and especially joint attention impairments, is one of the core features of the social impairments that children with ASD have (Franchini et al., 2019; Lee & Schertz, 2019). This dimension is broadly mentioned in all most recent DSM diagnostic manuals and it is a fundamental part in the construction of the main instruments used to realize the diagnosis of ASD. This consensus is extremely valuable to establish the diagnosis and it was possible thanks to the extent research that the recent years have brought. The fact that nowadays a firm diagnosis can be made using

instruments that rely on the assessment of non-verbal social communication abilities, among the evaluation of other dimensions, must be valued.

However, there is an important query that still remains open: is it possible to assess these non-verbal social communication abilities early in life to establish the risk that a child has to be diagnosed in the future? The average age in which an early diagnosis of ASD can be made is 2 years (Daniels & Mandell, 2002; Johnson & Myers, 2007). The enormous heterogeneity in the autistic socio-behavioural phenotype (Georgiades et al., 2013; Lenroot & Yeung, 2013; Lombardo et al., 2016; Mundy, 2019) and the implications attached to giving a false diagnose contribute to the fact that, despite autism being of a biological origin (Schmitz et al., 2006; Silver & Rapin, 2012) and, although the first signs can be observed during the first year of life in some cases (Ozonoff et al., 2010; Poon, Watson, Baranek, & Poe, 2012), the diagnosis is received relatively late (Turner-Brown, Baranek, Reznick, Watson, & Crais, 2013). Would it be possible to shorten this delay and realize some kind of early detection? The identification of early markers would allow the possibility of conducting early interventions, which could be of great help to those children who start to manifest the first impairments. Moreover, early intervention would most likely improve prognosis, both in those children who receive the diagnosis and those who do not end up with the disorder, contributing to the quality of life of infants and families (Dawson et al., 2010; Johnson, 2008; Kasari et al., 2010;

Kasari et al., 2012; Reichow & Wolery, 2009; Rogers & Dawson, 2010; Twyman et al., 2009; Zwaigenbaum et al., 2013).

The evaluation of early social communication abilities as early markers for ASD and as predictors for later language development is the core matter that articulates this work. In the following sections, we will go deeper into the different questions related to this topic. Chapter 2 will define which behaviours can be included under the label of *early social communication abilities*, when these abilities first start to emerge, and how they evolve through development. Chapter 3 will explore how these abilities are related to other aspects of communicative development, and it will expose the neural network that sustain them. Chapter 4 will explore the role of these early abilities in social-cognitive development in children with ASD, and how assessing early social communication can help identify first signs of autism at an early age. Finally, Chapter 5 will convey about groups of infant population with higher risk of showing early markers and higher risk of having ASD. Besides, it will explore the current situation that paediatricians, infant psychologists and other childhood professionals must face in terms of early identification.

CHAPTER 2: Early social communication abilities.

New-borns feel naturally attracted to human faces (Bedford et al., 2012; Droucker et al., 2013) and very young babies show a natural draw towards where and what the adult is looking (Farroni et al., 2004). Following this draw, and once gained control over their own visual attention around 3-4 months of age (Canfield & Kirkham, 2001; Gredebäck, Fikke, & Melinder, 2010; Perra & Gattis, 2010), babies learn how to deliberately align their own visual perspective with the other person around 8 months of age (Beuker et al., 2013). This gradual control over gaze orientation is possible because of the maturation of frontal brain areas, which allow control over attention (Mundy, 2016).

After participating in several of these synced gaze episodes, infants become more aware of the social responses they provoke in others and how their gazing behaviour tends to elicit contingent adult behaviour such as smiles, vocalizations and facial expressions of affect, as well as it can result in a physical response from the adult, such as picking them up or showing the object. That realization enhances the infant's likeliness of willing to engage in these social scenarios in the future, increasing the number of opportunities in which these social skills can be practiced (Mundy, 2016; Tomasello et al., 2005). Thus, we see how

babies feel strongly attracted to looking at the adult's gaze and looking together at one object or event of interest, but infants enjoy being the object of the adult's attention, too (Mundy, 2016; Senju & Johnson, 2009). In general, babies find the attention directed at them intrinsically gratifying. This is what is known as the *eye contact effect* (Senju & Johnson, 2009). It promotes their willingness to continue participating in interactions and that willingness increases the chances of benefiting from these situations. These context are the best scenarios for social learning to occur. This eye contact effect, emerges early in life and it plays a core role in differentiation of self and others as participants in a communicative act. This differentiation is at the base of the emergence of early social communication in their most basic forms around 6 months of age (Farroni et al., 2004; Gredebäck et al., 2010).

One of the main forms of early social communication is **joint attention**. Joint attention is defined as the ability of sharing attention with another individual to communicate common interest about an object or an event (Mundy & Newell, 2007; Salo et al., 2018; Scaife & Bruner, 1975). One of the first measures that were designed to assess joint attention in young infants was the first version of the *Early Social Communication Scales* (ESCS) (Seibert et al., 1982) in the 70s of the last century. In this same instrument, Seibert and col. (1982) differentiated between what have been traditionally labelled as the declarative function and the imperative function of joint attention (Bates,

Camaioni, & Volterra, 1975; Salo et al., 2018). The **declarative function** of joint attention refers to sharing a common focus with the purpose of communicating interest about the object and experiencing the joy of sharing this interest. On the other hand, the **imperative function** of joint attention is related to the use of communicative behaviours to achieve an objective, this is, to obtain an object or to get the other to do something that will be helpful to reach for a goal (Salo et al., 2018). Remember that we are talking about a baby and a caregiver in interaction. Therefore, this gain we are talking about would be a baby wanting the adult to bring an object closer to him, or a caregiver wanting the infant to do something with a toy. Seibert et al. (1982) suggested that these two components of early social communication reflect different facets of social-cognitive development and should be considered differently. Consequently, they decided to restrict the term joint attention only to the declarative use of this communicative behaviour and utilize the term *behavioural request* to refer to the imperative use of joint attention. Under this same approach, we will differentiate between these two dimensions of early social communication and we will use these terms following the same definitions from Seibert et al. (1982). From now on, we will be using the term *joint attention* when we want to talk about social communication used with declarative purposes, and we will use the term *behavioural request* to refer to this social communication used with the aim of obtaining a benefit. Additionally, we will mention a third dimension of

early social communication: *social interaction*. This third dimension is also included in the ESCS and it refers to episodes of face-to-face interaction and turn-taking games. It may involve the use of an object, but the object is not the main focus or reference. Some examples of this kind of dual interactions are tickling games or turn-taking games with a ball or a toy car (Mundy et al., 2003). These are the three dimensions that will be referred when talking about early social communication abilities. They will be defined in more detail in the following sections of this same Chapter: *joint attention* (section 2. 1.), *behavioural request* (section 2. 2.), and *social interaction* (section 2. 3.).

2. 1. Joint Attention.

Joint attention is the human ability to adopt a common point of reference with another person and share this mutual experience with them, coordinating visually, auditorily, and tactilely. In other words, joint attention is the ability to coordinate attention with someone to attend together an object or an event with the purpose of sharing interest in the object or the event (Mundy & Newell, 2007; Salo et al., 2018; Scaife

Figure 2. Image of a child initiating an episode of joint attention.

& Bruner, 1975). In figure 2 we can see a child displaying joint attention. The child is pointing to the object on the table to manifest the interest in sharing this episode with the adult who is sitting in front of him. Both infant and adult are focused on the same event and are synchronized in their mental representations, affect and behaviours.

Behavioural studies indicate that this ability begins to be observed in very young children. Different authors claim that the age of appearance oscillates from around 8-13 months (Beuker et al., 2013) or 9-12 months (Franchini et al., 2019; Mundy et al., 2009), although recent imaging studies are suggesting that it may have an earlier onset around 6 months of age (Mundy & Jarrold, 2010). The most common form of joint attention is gaze alternation between the person and the object (see figure 3). When the episode of joint attention occurs because the child initiates and leads it, this is called **initiating joint attention (IJA)**. For example, the child alternates gaze between the adult and the object. If it is the adult who initiates

Figure 3. Sequence of gaze alternation between the examiner and the object (IJAL).

the episode and the infant follows the adult's invitation, this is called **responding to joint attention (RJA)** (Johnson, 2008; Mundy, 2016; Tomasello et al., 2005).

It is worth emphasizing that joint attention is not simply to look at an object or event together. Young infants can have the ability of sharing the same focus with the adult, but not necessarily knowing what this sharing means. These first stages of joint attention could be better considered as *joint perception* (Bedford et al., 2012; Tomasello et al., 2005) or *mutual attention* (Siposova & Carpenter, 2019). At 8-10 months old, typically developing babies show shared focus when a mother who was interacting with them suddenly shifts her attention to an object, and the baby responds to this shift by turning his head towards this object (Johnson, 2008). These type of behaviours would constitute the first samples of joint attention and, although it implies an initial understanding of the intention of the mother's gaze, full capacity to understand this intention begins to be more commonly observed around 12 months old (Bedford et al., 2012; Franchini et al., 2019; Tomasello et al., 2005). Brooks and Meltzoff (2002) report that when infants are very young, adults' head-turning normally elicit infants´ head-turning, even if the adult has their eyes closed. However, after 12 months of age, children seem to be reluctant to follow the gaze of someone with their eyes closed, suggesting that they can understand the intentional meaning of the gaze of the others. Hence, children go from following the direction of the adult's gaze at 6 months old to

understanding the intent of this look at 12 months (Tomasello et al., 2005).

Contrary, other authors have claimed that even though the big explosion for joint attention occurs around the first year of life, the emergence of understanding the intentionality of others may have a much earlier onset than previously thought (Ibáñez et al., 2013). This is something that future research should help to elucidate.

But the fact that joint attention has an early onset should not confuse us that it is a simple skill. Joint attention requires that the child learns how to attend in parallel to (1) *self-referenced information* —interoceptive and proprioceptive information—, while (2) processing *other-referenced information* —the point of reference of the other person—, and (3) attending to *external or exteroceptive information* —the object or event which is being targeted by both participants in the social scene—. In brief, it entails the combination of self-referenced-information processing, other-person-information processing and external-information processing. Three convergent sources of information processed simultaneously. That is why joint attention is also referred to with the terms of *triadic attention* or *triadic communication* (Adamson, 1995; Johnson, 2008; Mundy, 2016).

This triadic processing is very important because it somehow brands the trajectory of joint attention through development from its emergence to its solidification. As mentioned, joint attention precedent

is *joint perception* (Tomasello et al., 2005). From joint perception, the infant begins to show an interest of following the gaze of the adult and frequently engages in episodes of alternating eye contact between the adult and the object, which finally constitutes joint attention. With these behaviours, the child is gaining awareness of its own perception, and its own intentions, and he is learning about the others´ perception and intentions. Only after the child has gained awareness of the others' internal mental representations and notices how he can elicit other's attention to self, he becomes systematically active in being the initiator of the episodes of joint attention (Tomasello et al., 2005). That is, the infant is initially a participant in a shared attention episode where he has been invited, but gradually gains experience and awareness and begins to engage in episodes where he is the initiator of the episode (Beuker et al., 2013; Thorup et al., 2018). That is why we distinguish between IJA and RJA. It is important to accentuate that these are two sides of the same element and must be differentiated. They respond to different cognitive processes (Mundy, 2003), are connected to different brain areas and paths, and are evolutionarily dissociated (Salo et al., 2018). Some studies have highlighted the lack of correlation between IJA and RJA (Salo et al., 2018; Thorup et al., 2018; Vaughan Van Hecke et al., 2007). RJA is evolutionarily simpler and that is why it emerges earlier in development. Normally, children first show the ability to respond to an invitation of shared interest (RJA) and then they acquire the skill of being able to initiate this behaviour themselves (IJA)

(Beuker et al., 2013; Thorup et al., 2018). RJA is controlled by a reflexive involuntary attention-regulating function that emerges early in infancy, whilst IJA develops later and it is regulated by activation of systems in the frontal lobe, associated with volitional attention and higher functions like working memory and executive functions (Salo et al., 2018; Vaughan Van Hecke et al., 2007). These two types of joint attention will be defined in more detail in the following sections.

Joint attention skills are acquired through lifelong learning in engaging with others, seeking their responses and responding to their prompts. Therefore, these are some skills that are primarily learned within social contexts which are responsive to the infant's cues and willingness to engage (Mundy, 2016). Children start to show first signs of joint attention when using eye contact and directing the adult's gaze to indicate a spot of interest at approximately 6 months old, and they more frequently show this behaviours around 9 months old (Mundy et al., 2007). When they are 12 months old, they start to display more complex types of joint attention, by complementing gaze direction with gestures such as pointing or showing (Matthews, Behne, Lieven, & Tomasello, 2012; Mundy et al., 2007; Mundy, 2016). So here, we must differentiate between *lower-level joint attention* and *higher-lever joint attention*. Children begin to exhibit their first behaviours of joint attention with more subtle signs such as gaze alternation between the adult and the object (see figure 3). Lower joint attention behaviours refer to these more basic ways of sharing interest about something with

the adult. As the child grows older and perfects his approaching of the world, and with the maturation of the cognitive system, the ways of showing joint attention maturate too, and higher joint attention emerges. These more complex ways of displaying joint attention include pointing, giving and showing when interacting with others (Mundy et al., 2007) (see figure 4). Thus, when we use the term **lower-level joint attention**, we are talking about evolutionary more basic behaviours (*eye contact* and *gaze alternation*), and when we refer to **higher-level joint attention**, we mean more complex behaviours (*pointing*, *giving* and *showing*, with or without eye contact). These two levels of joint attention must be differentiated because they carry a different gradation in terms of intentionality. Higher-level joint attention requires more intention since it is associated to the volitional use of gestures to share attention. On the other hand, eye alternation (lower-level joint attention) is more of an automatic result of social reference and requires less cognitive complexity to perform (Salo et al., 2018). These two subcategories of joint attention will be covered in more detail in the following sections.

All things considered, joint attention is the ability of sharing attention with others in regard to an object or an event (Mundy & Newell, 2007; Salo et al., 2018; Scaife & Bruner, 1975). It implies the processing of information about the world, about our minds, and about the other's mind. Infants need to have understanding of one's capacity to coordinate attention, while being aware of one's intentionality and

others' intentionality, in order to engage successfully in joint attention (Tomasello et al., 2005). Mastering this processing is not an easy task for infants —even the lowest levels of joint attention require complex processing, since it implies processing both simultaneously one's gaze and the other person's gaze (Mundy, 2016)—. As simple as it may seem when compared to other milestones in development— such that many times it appears insignificant to us and it is often underestimated— it is nevertheless essential in social-cognitive development (Mundy, 2016; Salo et al., 2018). Joint attention is fundamental to language acquisition, collaborative and cooperative behaviour, and social-cognitive development (Mundy, 2016; Salo et al., 2018). It requires years to develop and it continues to play a role in human development after its complete acquisition (Böckler, Knoblich, & Sebanz, 2012; Mundy, 2016). All in all, children, just like adults, enjoy sharing personal moment-to-moment spotlight with other people —we humans like that more than any other animal—, and adopting a common point of view with others is necessary to share these experiences. This sense of sharing contributes to our feelings of connection and belonging to others (Mundy, 2016; Wolf, Launay, & Dunbar, 2016). Joint attention and referential information develop in other animals as a foundation for collaborative behaviour and it would not be surprising that this may be the case in humans too (Tomasello, 2008). Disturbances in joint attention are considered one of the pivotal characteristics of early signs of ASD yet identified (Lee & Schertz, 2019; Mundy, 2016). No other

dimension is claimed to have evidence for its centrality to define social deficits in ASD since Frank Curcio (1978) first talked about it as a feature of infants with autism (Mundy, 2016). Besides, joint attention impairments seem to be a stable feature from early development and through preschool stage in children with ASD (Mundy, Sigman, & Kasari, 1990). The importance of joint attention, and other early social communication abilities, in the identification of early signs of autism will be covered in greater detail in Chapter 4.

2. 1. 1. Initiating Joint Attention (IJA)

Initiating joint attention (IJA) refers to those episodes of joint attention when is the child who voluntarily directs the adult's gaze towards an object or event of interest (Mundy, 2016). The most common form of IJA is when the infant alternates the gaze between the adult and the object, when he points to the object and seeks the reaction of the adult, or when he grabs the object and shows it or gives it to the adult (Mundy et al., 2003). It is one of the core early social communication social skills and, according to different studies, it

Figure 4. Image of a child pointing to a picture on the wall (IJAH without eye contact).

typically starts to emerge in its more basic form between 8 and 13 months old (Beuker et al., 2013; Franchini et al., 2019; Mundy et al., 2009), yet recent imaging studies are pointing out that it may have an earlier appearance around 6 months of age (Mundy & Jarrold, 2010).

How does this communicative behaviour evolve through early development? This is a pertinent question because, generally, the different behaviours that integrate under the label of *early social communication skills* tend to have an earlier or later emergence (from 6 to 12 months old) and then they increase progressively through development until its consolidation (around 18 months). Nonetheless, IJA does not show this steady increase with age from 8 to 18 months. It increases from 8 to 10 months, tends to decline through 15 months, and seems to rebound to 18 months (Ibáñez et al., 2013; Mundy et al., 2007; Sheinkopf, Mundy, Claussen, & Willoughby, 2004) (see figure 13 in page 113; Chapter 5). This non-steady pattern development of IJA may be due to the emergence of walking, which is occurring at the same time and, and that provokes a developmental challenge. This fact somehow forces the communication skill to recede while the energies are focused on the big defy that is learning how to walk, to make a comeback once this has been relatively mastered (Mundy, 2016).

We can distinguish between **lower-level IJA (IJAL)** and **higher-level IJA (IJAH)**. These two labels (*lower* and *higher*) that may accompany the different behaviours of early social communication were defined in section 2. 1. IJAL refers to behaviours of a simpler nature evolutionarily,

such as, eye contact with the adult or gaze alternation between the object and the adult (see figure 3). Younger infants use these lower-level behaviours more frequently. IJAH refer to behaviours of a more complex nature evolutionarily, such as, pointing, showing and giving (see figure 4). They require that the child had displayed lower-level behaviours of IJA before starting to show higher-level behaviours of IJA. This latter involves the understanding of the social use of certain gestures and, sometimes, the combination of these gestures with eye contact (Salo et al., 2018) (see figure 5). Older infants tend to use these higher-level IJA behaviours more frequently. Gaze alternation is observable at 8-9 months old (Beuker et al., 2013; Thorup et al., 2018), whilst IJAH tends to emerge after 10 months (Beuker et al., 2013). Therefore, just like it occurs with IJA and RJA, we see how these two levels of IJA respond to different processes and, although connected, they are ultimately independent (Pickard & Ingersoll, 2015). Indeed, some authors have hypothesised that the nonlinear pattern which characterizes the growth of IJA development is due specifically to the fact that what decreases is IJAL and it does so in favour of IJAH

Figure 5. Image of a child pointing to a picture on the wall (IJAH with eye contact).

increasing. This is, older children tend to rely less on eye alternate (IJAL) to display joint attention because they start to use gestures to communicate (IJAH). Gestures substitute the gaze alternation (Pickard & Ingersoll, 2015).

To conclude, impairments in joint attention is considered to be one of the strongest markers for early identification of ASD (Adamson et al., 2019; Lee & Schertz, 2019; Mundy, 2016; Thorup et al., 2018). Specifically, it is considered that impairments in IJA are central to the nature of the social difficulties in ASD and they offer one of the most reliable manifestation of early signs for the disorder (Curcio, 1978; Ibáñez et al., 2013; Macari et al., 2012; Mundy et al., 2007; Mundy, 2016; Schertz et al., 2018; Thorup et al., 2018). Some authors claim that it is higher-level IJA the joint attention behaviour that has the greater precision when identifying the risk of autism (Chiang, Soong, Lin, & Rogers, 2008; Pickard & Ingersoll, 2015).

2. 1. 2. Responding to Joint Attention (RJA)

Responding to joint attention refers to the episodes of joint attention where the child follows the invitation to participate in a joint attention episode, by directing their gaze to the object or the event the adult is referencing (Mundy, 2016). The most common form of RJA is when the infant turns the head to see the object the adult is pointing (see figure 6). The head-turning alone is RJA but sometimes the child also points to the object the adult is referencing. Depending on the distance where the object is, we can talk about proximal-RJA (RJAP) and distal-RJA (RJAD). If the object the adult is referencing and the child is responding to is at a short distance, this is called RJAP. If the object the adult is referencing and the child is responding to is at a longer distance, this is called RJAD (Mundy et al., 2003). An example of RJAP would be a situation in which an adult and a child are sitting on a mat going through a book together, pointing to the images of the book and talking about them. An example of RJAD would be a situation in which an adult points to a picture on the wall and the child turns his head to see this picture (Mundy et al., 2003) (see

Figure 6. Image of a child responding with a head-turn to a cue from the examiner (RJAD).

figure 6). Infants are able to adequately respond to a bid for joint attention when the object is close, this is, to display RJAP, around 9-10 months old. RJAD emerges later in development, since distal objects require higher skills to be identified. Children typically respond appropriately to RJAD around 14-15 months old (Salo et al., 2018).

Both IJA and RJA are affected by motivation and reward but research suggests that initiating joint attention, as needing more of the voluntary willingness of the initiator of the episode, holds a stronger influence of motivation than responding to joint attention (Gordon, Elibott, Feldman, Pelphrey, & Vander Wyk, 2013; Schilbach et al., 2010; Vaughan Van Hecke et al., 2007). RJA is also a more relatively easy measure to observe in experimental situations, and it is more often targeted in interventions for social communication improvement with greater success than IJA (Meindl & Cannella-Malone, 2011). RJA can be easily elicited by a tester, or stimulated by a practitioner, but IJA processes require this motivation element which makes more difficult to set up in certain conditions. RJA involves more reflexive functions, while IJA is more self-generated/volitional (Lee & Schertz, 2019; Mundy, 2016). Besides, RJA emerges earlier in development and it is evolutionarily simpler. Typically, children first develop the skill to respond to joint attention (RJA) and later they acquire the ability to initiate this behaviour themselves (IJA) (Beuker et al., 2013; Thorup et al., 2018). However, that does not remove any complexity to RJA. RJA requires the infant to first orient to the adult and then inhibit the

attraction to the adult's face in order to redirect the attention to the adult's gaze (or the adult point of reference) to find the object. Then, the child must pull away their immediate attraction and information seeking about the object to return the attention to the adult (Mundy, 2016).

RJA emerges in the first 4 months of age and tends to consolidate around 6-8 months of age (Gredebäck et al., 2010; Perra & Gattis, 2010; Salo et al., 2018; Thorup et al., 2018). Once it has been relatively mastered, around 9 months of age, infants gain some more improvement educing response latency during the following months (Gredebäck et al., 2010). Vaughan Van Hecke et al. (2012) outline a remarkable decline from an average of 1.77 seconds per trial at 9 months old to an average of 0.86 seconds per trial at 18 months old. Studying the latency of the response can shed some light on the continuous nature of RJA, with infants not only going from not being able to execute it to displaying it, but increasing efficiency as well.

In conclusion, RJA is the ability to respond to an adult's cue for participating in a situation of joint attention. It is evolutionarily simpler and emerges earlier than IJA. Nonetheless, that does not detach any complexity from it. To display RJA, the child must first direct his attention to the adult to later inhibit this attention and switch focus to the object, and then do the same process again to bring the attention back to the adult. After RJA is relatively mastered by the infant, it is improved in terms of latency, increasing the beneficial effect of

participating in these triadic situations has. RJA is related to language acquisition and other socio-cognitive milestones later in development (Mundy & Newell, 2007; Salo et al., 2018; Wu, Pan, Su, & Gros-Louis, 2013). This issue will be covered in Chapter 3.

2. 2. Behavioural Request.

So far, we have been talking about joint attention and we have been talking primarily about the declarative compound of early social communication. This declarative function of joint attention is defined essentially by someone's willingness of sharing interest with somebody else in relation to third element. This is what we have been calling joint attention. But early communication skills can be used to achieve other purposes too. Triadic communication between infant, adult and object can occur because one of the interlocutor wants to obtain the object and he communicates with the other interlocutor to achieve this goal (Mundy, 2016; Salo et al., 2018). In this case, although some authors would refer to this imperative use of joint attention with the same term, other researchers applicate another term to differentiate joint attention when used for declarative purposes and joint attention when used for imperative purposes (Salo et al., 2018). This kind of triadic communication used to obtain a given benefit is called *behavioural request*. According to this approach, when the infant and the adult are sharing joy and interest, they are showing *joint attention*, but when

they are maintaining eye contact and alternating the gaze because they want to communicate to the other that they want to get something (e. g. the infant wants the adult to bring the toy closer to him), then they are showing *behavioural request*. This differentiation is important because impairments in joint attention, specifically in IJA, are more frequent in infants in ASD (Franchini et al., 2019; Schertz & Odom, 2007; Schertz et al., 2018; Thorup et al., 2018), while request skills are relatively preserved in children with autism (Baron-Cohen, 1992; Camaioni, Perucchini, Muratori, Parrini, & Cesari, 2003; Tomasello & Camaioni, 1997).

In addition to that, the differentiation between joint attention and behavioural request is important since literature indicates that displaying IJA without accompanying positive affect is often observed in individuals with ASD, and it can be an early indicator for ASD risk, but this is not the case for behavioural request. It seems that positive emotions can occur contingently with behavioural request in children with ASD (Gangi, Ibáñez, & Messinger, 2014; Kasari, Sigman, Mundy, & Yirmiya, 1990). This is, children with ASD tend to make less use of positive affect accompanying IJA but they may display positive affect when showing behavioural request (Kasari et al., 1990). Thereby, measures of positive affect that do not consider the context in which this occurs would not be the best indicator for ASD risk since it is not unusual to see positive regard in individuals with autism if it is used with imperative purposes (Mundy, 2016).

When the episode of behavioural request occurs because it is the child who wants to obtain something and it is the child who initiates the episode —for instance, the child alternates gaze between the adult and the a wind-up toy because he wants the adult to activate the toy when this stops—, this is called **initiating behavioural request (IBR)**. If it is the adult who initiates the episode —for instance, he asks the child to give him the toy and the child does so—, this is called *responding to* **behavioural request (RBR)** (Mundy et al., 2003). These two types of behavioural request will be covered in more detail in the following sections.

2. 2. 1. Initiating Behavioural Request (IBR)

The *initiating behavioural requests* (IBR) refers to the child directing the adult's attention to objects because he wants to obtain them (or wants to obtain something from the adult). For example, toys that are out of reach. Another example of IBR would be an infant alternating the gaze between the adult and the object after the object, which was active, has ceased moving. This gaze alternating would indicate that the child wants the adult to activate the object again. It is a type of triadic communication with imperative purpose.

We can distinguish between **lower-level IBR (IBRL)** and **higher-level IBR (IBRH)**. These two labels (*lower* and *higher*) that may accompany the different behaviours of early social communication were defined in

section 2. 1. IBRL refers to behaviours of a simpler nature evolutionarily, such as, the use of eye contact, gaze alternation with the adult or extending arms towards an out-of-reach object for instrumental purposes (with or without eye contact). Younger infants use these lower-level behaviours more frequently. IBRH refers to behaviours of a more complex nature evolutionarily, such as, pointing, showing or giving for instrumental-imperative purposes (see figure 7). They require that the child had displayed lower-level behaviours of IBR before starting to show higher-level behaviours of IBR since this latter involves the understanding of the social use of social gestures and, sometimes, the combination of these gestures with eye contact. Older infants tend to use these IBRH behaviours more frequently. Just like it occurs with IJAL and IJAH, it seems reasonable to realize this type of distinction with IBRL and IBRH. These two dimensions could be related to independent processes, could have different associations with other developmental outcomes and could be informing differently about ASD early markers.

Figure 7. Image of a child giving the object to the examiner as a petition for its re-activation (IBRH).

In conclusion, IBR is the ability of displaying joint attention for imperative purposes and it may include behaviours of a more basic nature, such as gaze alternation (IBRL), or more complex actions, which include gestures such as giving, showing or pointing (IBRH). Children with autism regularly make eye contact and use gesture to do requests, this is, exhibit IBR, yet rarely use eye contact and gestures to share interest with others (Curcio, 1978). In other words, children with autism often engage in social situations when motivated to obtain an object (imperative purposes) but they do not always share their experience about the object or show interest in sharing joy (declarative purposes) (Baron-Cohen, 1992; Camaioni et al., 2003; Tomasello & Camaioni, 1997). This is, children with autism display episodes of IBR in a higher frequency than they do IJA (Mundy, 2016).

2. 2. 2. Responding to Behavioural Request (RBR)

Responding to behavioural requests (RBR) refers to the child's skill in responding to the adult's gestural or verbal simple commands to obtain an object or to get the child realize an action. An example of RBR would be a child responding to the command "Give it to me" by leaving the toy over the adult's hand. This same order can be either done only with the verbal order or with the combination of the verbal command and an accompanying gesture (palm-up gesture). This is worthy to be remarked because sometimes it is important to know if the order was followed because the child is capable of understanding the oral

command —meaning that the child has good receptive language skills in that category—, or that the oral command is not enough for the child to understand it and it requires the assistance of the gesture to understand the message —receptive language skills are not completed to the extent that they understand this command— (Mundy et al., 2003).When the child responds to an order which was emitted only oraly, this is, not accompained by a gesture, we call that **responding to behavioral request without gesture (RBRWO)**. When the child responds to an order accompained by a gesture, we refer to **responding to behavioral request with gesture (RBRW)**. Tipically, younger children require the gesture to help understand the command (RBRW) and, as they get older, they start to display RBR only with the oral command (RBRWO).

This ability of responding to a request seems to be less present in younger children and it appears to be relatively consolidated only after the first birthday (Mundy, 2016). In figure 8 we can see the growth patterns of IBR, RBR, IJA and RJA. We can see the lower scores in early ages such as 9 months old and how the general tendence is to abrubtly grow around the frist birthday and then stabilize (or have a more subtil growth) in the following months. However, we must carefully address the IJA case, since its growth follows a different pattern. A mentioned in Section 2. 1. 1. of Chapter 2, IJA development tends to be ascendant from 8 to 10 months, then declines around 15 months, and seems to rebound from 15 to 18 months (Ibáñez et al., 2013; Mundy et al., 2007;

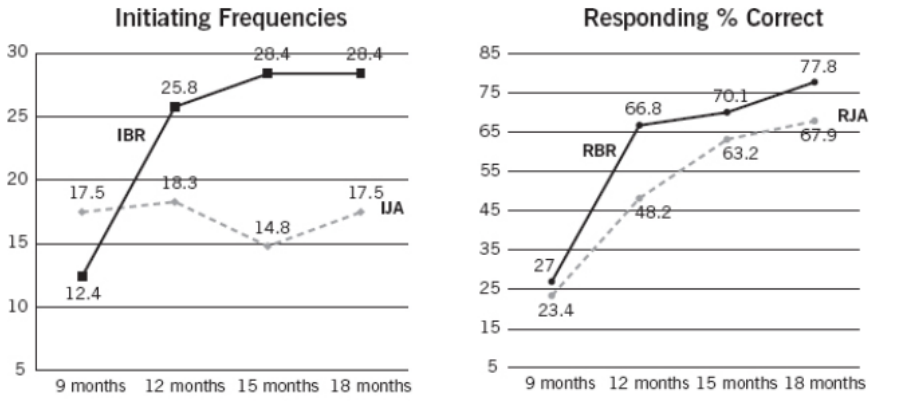

Figure 8. Illustration of the growth patterns of IJA, RJA, IBR and RBR in typical development between 9 and 18 months of age. Recovered from Mundy (2016, p. 70) with permission.

Sheinkopf et al., 2004). This figure illustrates this nonlinear cubic growth pattern observed for IJA development in general infant population. In addition to that, this figure would be also showing how the different measures of early social communication do not necessarily follow a similar pattern (Salo et al., 2018; Thorup et al., 2018; Vaughan Van Hecke et al., 2007). In fact, they respond to different processes and are linked to different brain networks. While IJA and RJA are associated with activation of the posterior and anterior attention systems, IBR and RBR are not as clearly associated to these areas (Mundy et al., 2007). The biological substrate of joint attention will be covered in more detail in section 3. 5. of Chapter 3. While the measures for joint attention hold the biggest weight in predicting outcomes such as language or ASD early symptomatology (Franchini et al., 2019; Schertz & Odom, 2007; Schertz et al., 2018), the dimension of behavioural request hold less of the weight in this sense (Colonnesi,

Stams, Koster, & Noom, 2010). Finally, social motivation is contributing to individual differences in IJA, but less so in RJA or IBR and RBR (Mundy et al., 2007).

For that reason, these different dimensions of ESC and their subtypes must be assessed separately. Generalizing the association between all different dimensions in ESC and other developmental outcomes, and linking all types of ESC to early identification of ASD signs would be irresponsible. Great caution should be applied regarding this issue (Mundy et al., 2007).

2. 3. Social Interaction.

Social interaction refers to those behaviours where child and caregiver engage in playful, affectively positive, mutually regulated, reciprocal, and harmonious activities (Harrist & Waugh, 2002). These activities include turn-taking games, imitation, and other games of exchange. Typically, in a situation of social interaction, the child successively responds to an adult's cue and a socially oriented back-and-forth interaction is initiated (Schertz et al., 2018). It may involve the use of objects, such as a ball or a toy car, but the objects are not the focus or main point of reference. Social interaction is more related to regulating face-to-face interaction (Mundy et al., 2003) and it is crucial to children's social, emotional, and cognitive growth (Harrist & Waugh, 2002). Some examples of social interaction episodes are: an

adult and a child conducting a turn-taking game with a ball, adult and child playing with a hat, a comb or a pair of glasses (Mundy et al., 2003) (see figure 9). When the child responds to the adult's invitation to participate, for example, in a game of turn-taking or a tickling game, this is called **responding to social interaction (RSI)**. If it is the child who shows the initiative to open the turn-taking sequence or shows a tendency to, for example, tease the adult by throwing the ball on the floor and seeing the adult's response, this is called **initiating social interaction (ISI)** (Mundy et al., 2003). *Lower* and *higher-level* behaviours are not differentiated for ISI but are differentiated for RSI.

Figure 9. Image of a child responding to the invitation of social game (combing the examiner) (RSIH).

This form of communication differs from the other two types — joint attention and behavioural request— in the sense that social interaction is fundamentally *dyadic*. This form of social engagement is essentially defined by two partners in interaction. Joint attention and behavioural request episodes are classified as triadic communication, and they have the special characteristic that they go beyond the partners. In dyadic interactions, the kind of information processing that is most likely to occur is information processing about the social

partner, while triadic communication triggers a greater cognitive processing since it involves information processing about a third element (the point of reference). Triadic communication is the best scenario for spontaneous instruction and learning to befall, since joint attention often benefits from the *eye contact effect* (see Chapter 2) and operates as an enhancer to information processing which transfer from information of another person to shared information about a third object, event or idea (Kopp & Lindenberger, 2011; Lee & Schertz, 2019; Mundy, 2016). Awareness of the other's point of reference that occurs in triadic communication, more than the awareness of the other that occurs in dyadic communication, is a strong signal to the baby's brain to pay attention to something important to look at (or listen to) and that multiplies the effectiveness of learning (Mundy, 2016).

Although triadic communication seem to be the ESC ability which receives most of the attention when it comes to predicting the risk of ASD, some authors advocate for the social dimension of *social interaction* to be also informative (Poon et al., 2012). In addition to that, social interaction has been reported set one of the foundations for later language skills. Dyadic back-and-forth interactions create the perfect context for babies to learn how to participate in situations which simulate a real conversation. From social interaction episodes babies extract an extremely valuable learning and that is that successful interactions result from both parts carefully respecting turns, which is the precursor of what a real conversation is (Lee & Schertz, 2019).

Finally, social interaction could also be considered to be at the base of joint attention, since triadic communication emerges from dyadic communication. Triadic communication would be the result of a dyadic interaction where, once the infant have acquired the ability to switch and manage his attention, a third element is introduced (Schertz et al., 2018). This is the reason why social interaction has been used as a starting point to promote joint attention for children with autism, who normally have greater difficulties with triadic communication (Isaksen & Holth, 2009; Schertz et al., 2018).

2. 3. 1. Initiating Social Interaction (ISI)

Initiating social interaction (ISI) occurs when the child initiates the episode of social interaction. A prototypical situation of ISI would be a child and an adult playing where the child grabs a ball and throws it to the adult expecting that the adult throws it back in a sequence of back and forth game (Mundy et al., 2003). The important element in this episode is that it is the infant who has initiated the sequence. Other behaviours which hold clear intention of initiating a social interaction, and would fall under the label of ISI, are when the child engages in a somehow "prohibited act", such as pulling an object away from the adult after an explicit request ("Give it to me"), or dropping the ball to a different direction rather than returning it to the adult during a turn-taking game. This type of *teasing behaviour* gives the child a better understanding of how their behaviour affects the people around them

and how he can somehow control the outcome of the interaction. It requires full initiative and that is why it is included as an ISI behaviour (Mundy et al., 2003).

2. 3. 2. Responding to Social Interaction (RSI)

Responding to social interaction (RSI) occurs when the child follows the invitation of the adult to engage in a game of face-to-face social nature. For example, in a child-adult turn-taking game, upon the receipt of a car or a ball, the child rolls the car or the ball back to the adult (Mundy et al., 2003).

As mentioned, *lower* and *higher-level* behaviours are not differentiated for ISI, but they are differentiated for RSI. Thus, we can distinguish between lower-level RSI (RSIH) and higher-level RSI (RSIL). RSIL refers to discrete behaviours, such as eye contact, or excited responses expressed gesturally, vocal or physically (with or without eye contact), such as hitting the table, which mean that the infant is willing to follow the adult's invitation to interact. These behaviours are considered more basic responses to the invitation of the adult to participate in a social game since the response that the child gives in these situations is more reactive. A prototypical situation of RSI would be a scene of a caregiver tickling the infant or doing nursery rhymes, such as "Row, row, row your boat", and an infant displaying eye contact with the adult and laughing. RSIH refers to the infant accepting to

participate in a situation of social interaction which the adult has initiated, for example a turn-taking game, or the infant following the invitation of a game about putting a hat or a pair of glasses to the other person (Mundy et al., 2003). Despite still being a response to a social invitation, RSIH requires some more amount of willingness to participate in the interaction that RSIL.

To sum up, social interaction is used as a label to refer to communicative situation with baby and adult interacting face to face. It can be that the caregiver leads the interaction and the baby responds to it (RSI), or it can occur that the infant is the one who initiates the episode (ISI). Compared to the other two dimensions, the dimension of social interaction has its peculiarity, as it is dyadic and it is evolutionarily simpler. Both joint attention and behavioural request are triadic and have been more strongly related to other milestones in social-cognitive development, as well as to early markers of ASD. In the following Chapter, the role of ESC in socio-cognitive development in typically developing children will be discussed.

CHAPTER 3: The role of early social communication in socio-cognitive development.

The role of social early communication skills in social-cognitive development can be understood with *the Parallel and Distributed Processing Model* (PDPM) by Mundy et al. (2009). This theory conceives joint attention as a parallel processing, because it involves the simultaneous processing of information about self/attention and others' attention, and a distributed processing, because it occurs across distributed brain networks, rather than in isolated brain regions. In some way, this theory describes information processing in the same way it seems to take place in the brain.

According to this approach, cognitive development is conceived as a continuum, with joint attention development emerging from the increase in speed, efficiency and complexity of several processes. These processes are the encoding of (1) internal information about one's attention, (2) external information about others' attention, (3) information about spatial, temporal and semantic information about a common focus, and (4) the neural network that integrate all this processing (Mundy, 2016). In that sense, PDPM assumes that joint attention is not a following stage which replaces previous stages but it is part of a development of abilities that are acquired starting from the

previous skills and adding new dimensions to these skills (Mundy, 2016). The new stages are always present in the subsequent stages. Instead of being replaced, joint attention remains active through cognitive development and thought adulthood and becomes scaffolding for later learnings in development (Kim & Mundy, 2012; Mundy & Newell, 2007; Mundy & Sigman, 2006; Redcay, Kleiner, & Saxe, 2012; Schilbach et al., 2010). Thus, joint attention development can be conceived within the development of a social cognition as: from early stages of learning *to do* joint attention (2 to 9 months old) to learning *from* joint attention after this ability have been mastered (Mundy et al., 2009; Mundy & Vaughan Van Hecke, 2008). This is, infants learn how to display joint attention and then they learn how to use this skill to acquire other social abilities. Individuals with ASD have a longer learning-to phase. This could be explaining their difficulties in joint attention in early ages and the delays (or inabilities) in achieving further developmental milestones (Mundy, 2016).

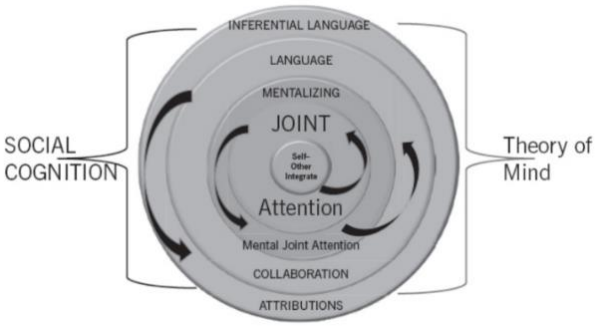

Figure 10. Illustration of the continuous nature of joint attention development. Recovered from Mundy (2016, p. 103) with permission.

In outline, socio-cognitive development can be seen as a continuous spiral of human development that, in an inside-out process, and given certain core abilities—information about self and others, joint attention, etc.— enables the emergence of other human dimensions, such as symbolic thinking and language, mentalizing and theory of mind, and social cognition (Mundy, 2016; Mundy et al., 2009; Humphreys & Bedford, 2011) (see figure 10). Joint attention is an essential and a constant in socio-cognitive development. "It may be useful to think of joint attention as an engine of human social-cognitive development" (Mundy, 2016, p. 192).

3. 1. Early social communication and learning.

The acquisition of joint attention abilities during infancy are one of the main foundations for adult socio-cognitive development and learning (Bruner, 1995; Mundy, 2016). Several studies have highlighted how differences in joint attention during early development seem to be associated with the variability in learning outcomes later in development (Mundy, 2016; Thorup et al., 2018). In fact, the term "joint attention" was first used by Bruner (Bruner, 1995) when he and his colleagues conducted a research to study how infants learn. They claimed that adopting a common frame is the context where instructional and spontaneous learning is more likely to occur, and that shared knowledge is essential to all forms of pedagogy. That is why we

can say that joint attention is in the basis of **learning** (Bruner, 1995; Mundy, 2016).

Joint attention abilities are also pivotal for the occurrence of **social learning**, which can be defined as the acquisition of new learnings by observing and imitating others, using them as the model (Bandura, 1962). Thus, impairments in joint attention do not only affect moment-to-moment social interaction, but they can have an effect on referential social learning (Mundy & Crowson, 1997).

Besides, early triadic communication abilities appear to play an important role in the creation of a common framework, which facilitates **cooperative behaviour** (Sebanz, Bekkering, & Knoblich, 2006; Wu et al., 2013), and **problem solving** with peers (Böckler, Knoblich, & Sebanz, 2011). In particular, measures of RJA —and not so much IJA measurement— are related to a higher tendency to engage in cooperative behaviour (Sebanz et al., 2006).

Nevertheless, these differences in the strength of the associations may be due to the fact that these two dimensions of joint attention may result helpful depending on the type of the task being performed. Cooperative behaviour has been assessed, and linked to joint attention using two type of tasks: (a) Complementary-actions tasks; and (b) Simultaneous-identical-actions tasks. A complementary-actions task requires one of the participants doing one action and the other participant doing another action which completes the previous action

(complementary roles). A simultaneous-identical-actions task means that both participants are doing parallelly the same action (parallel roles). When these two types of tasks are associated with joint attention, IJA seems to be related to cooperative behaviour in tasks of different but complementary actions, while RJA seems to be related to cooperative behaviour in tasks of simultaneous identical actions (Wu et al., 2013).

3. 2. Early social communication and executive functions.

As mentioned, triadic communication requires the use of those skills which permit attention managing and inhibitory control (see Chapter 1). Therefore, it could be reasonable that some aspects of early social communication have shown to be related to cognitive control.

It seems that differences in early RJA behaviours tend to predict differences of success in a *delay-of-gratification task* at 24 and 36 months (Morales, Mundy, Crowson, Neal, & Delgado, 2005; Vaughan Van Hecke et al., 2012). This could be explained because the executive function system plays a role in regulating RJA and it is also fundamental in the capacity to remove attention from a central stimulus in order to allocate attention in another goal. In a *delay-of-gratification task*, the infant is sat in front of a sweet. He receives the instruction that if he does not eat the sweet straight away and he is patient enough to wait

for some minutes, he will receive a bigger treat. In this case, the central stimulus is the sweet and the child must be able to disconnect from it in order to focus on the new goal: to achieve the bigger reward. This complex task requires some to great inhibitory control and this feature of the executive functions seem to be both under the success of the correct **management of gratification** and joint attention (Jahromi, Chen, Dakopolos, & Chorneau, 2019; Mundy, 2016; Mundy & Sigman, 2006).

Several studies have studied the relationship between executive functions and joint attention, suggesting that less mature performance in RJA more likely lead to poorer executive functions (Gago Galvagno et al., 2019). On the other hand, IJA measurements have been associated with the later emergence of executive functions (Miller & Marcovitch, 2015).

3. 3. Early social communication and language.

Early social communication performance during early infancy is also related to the emergence of **symbolic thinking** and **language** later in development (Jones et al., 2009; Salo et al., 2018). Charman et al. (2000) reported associations between IJAL and language, and Beuker et al. (2013) exposed the contributions of joint attention to early lexical development. Mundy et al. (2007) also explored the relation between

both IJA and RJA with language development in typically developing children.

How can these associations between joint attention and language be explained? Joint attention can be seen as the scaffold of symbolic development (Tomasello et al., 2005), this is, adopting a common focus is the essence where human language and symbolic representation resides (Colonnesi et al., 2010). Language and conversation are, in other words, triadic communication: two individuals and an object (the topic of the conversation). In that sense, language is like the highest level of joint attention, and joint attention is like the predecessor of what a real conversation is. Linguistic symbols are dependent upon the efficiency of social attention coordination to common abstract representations. This does not mean that joint attention leads to symbolic thinking and language development, but symbolic thinking and language development involve great part of joint attention capacity (Adamson, Bakeman, & Deckner, 2004; Mundy, 2016).

According to the PDPM, during symbolic thinking processing, neural networks associated with joint attention activate just as networks associated with cognitive representations do (Mundy, 2016). Younger children use pointing and showing to establish a common point of reference with someone else, as older children use symbols (e. g. language) to establish a common point of reference with someone else (Mundy, 2016).

Early language learning, and especially **vocabulary acquisition**, habitually occurs in unstructured spontaneous situations called "point-and-tell" where parents naturally identify the gaze of attention of their child and refer to this object (Sedivy, 2014). If we flip the phenomenon, lexical acquisition also occurs in situations of RJA: infants identify the parent's reference, respond contingently to it while listening to the verbal label that is being given to the object concurrently (see figure 11). Thus, language learning occurs bout in IJA and RJA situations (Mundy et al., 2007; Yu, Sumarga, & Smith, 2019) and that facilitates this milestone tremendously.

Figure 11. Illustration of the spontaneous context of language learning and the utility of joint attention. Recovered from Mundy (2016, p. 160) with permission. Based on Baldwin (1995).

Responding to an invitation of joint attention means that the infant is capable of understanding the intentions of others and that is why RJA has been connected to **receptive language** (Salo et al., 2018). But especially following the child's interest when he uses IJA serves to create the optimal situation for language learning, being that the child is an active part in it (Mundy, 2003). Thus, we can say that joint attention might be in the base of adequate vocabulary gain, and that

can be seen in the fact that children with better joint attention skills tend to perform better in language tasks (Colonnesi et al., 2010; Salo et al., 2018).

In the same line, Pickard and Ingersoll (2015) suggest that better performance on IJAL is associated with better language development. On the contrary, it appears that children who have lower presence of IJAL at 9 months old —and lower levels of parent-child book reading— tend to have lower levels of receptive vocabulary at 4-5 years old (Farrant & Zubrick, 2012). With respect to language skills beyond vocabulary acquisition, the use of gestures to display joint attention appears to predict two-word sentences (Özçalişkan & Goldin-Meadow, 2005) and syntactic complexity at 3 years old (Rowe & Goldin-Meadow, 2009).

This association between joint attention and language skills seems to be especially strong in the case of triadic communication used with declarative purposes and not so much when talking about triadic communication used with imperative purposes (Colonnesi et al., 2010; Salo, Reeb-Sutherland, Frenkel, Bowman, & Rowe, 2019; Southgate, Van Maanen, & Csibra, 2007). This would also give some bases over the idea that declarative joint attention is cognitively more complex than the imperative one. In other words, joint attention is more complex cognitively than behavioural request (Salo et al., 2018). Declarative communication is linked to the brain regions associated with will,

motivation, emotional/affective expression and intersubjectivity (Committeri et al., 2015).

However, behavioural request has also been connected to language development, although it has been restricted to links with receptive language (Salo et al., 2018). The imperative function and the declarative function are equally complex communicative behaviours. Behavioural request requires complex attention management skills as much as declarative communication. In addition to that, it requires cooperative motivations to participate in some kind of interaction with other (Van der Goot, Tomasello, & Liszkowski, 2014). We could expect the imperative use of joint attention to be connected to language skills because it is also related to motivation to learn how to use language to achieve an objective efficiently. With the child expressing their needs through behavioural request and the caregiver naming the objects of desire, the child can easily establish the association between the labels —the spoken words— and their referents, consequently leading to vocabulary acquisition (Harbison, McDaniel, & Yoder, 2017). Thus, some researchers do not claim declarative communication as being a superior predictor than imperative communication for word acquisition (Lüke, Grimminger, Rohlfing, Liszkowski, & Ritterfeld, 2017).

We must also accentuate how social interaction behaviours have been linked to language development as well. These type of dyadic, back-and-forth interactions, allow young children to learn to participate in interactions which require respecting turns and comprehending the

other person's perspective, and that is not other thing that the precursor for having a conversation (Lee & Schertz, 2019). In other words, social interaction scenarios facilitate the acquisition of communication skills, which constitute part of the elements that set the bases for language development. Social interaction offers the child the perfect opportunity to practice what could be a simulation of a conversation (Lee & Schertz, 2019). Repeated, structured, and reciprocal activities precede the development of shared meaning and, hence, language learning. Moreover, when participating in dyadic games, caregivers have this spontaneous impulse to use language to describe things like the actions that are taking place. Thus, children learn to associate these terms to the situation occurring in that moment (Harrist & Waugh, 2002). Finally, measures of IBR and RBR do not seem to hold validity in the prediction of linguistic outcomes and have been less consistently related to language, cognition, and other social outcomes in previous research (Mundy et al., 2007).

In conclusion, it appears that ESC performance during early ages — and in particular the dimensions of joint attention and social interaction— is a strong predictor for productive vocabulary in later development and, it seems that every dimension of ESC is differently connected to different aspects of language development (Salo et al., 2018). IJA and RJA are both related to lexical acquisition (Farrant & Zubrick, 2012; Mundy et al., 2007; Pickard & Ingersoll, 2015). It is worth mentioning that RJA seems to correlate significantly with both

concurrent and later measures of word acquisition, while IJA seems to be primarily restricted to current language (Adamson et al., 2019). Behavioural request and social interaction are also related to receptive and expressive vocabulary respectively (Salo et al., 2018). However, a new question may appear now: Is the contribution of early social communication restricted only to language acquisition? The answer seem to be that joint attention is not only the antecedent for language development, yet it is the antecedent for almost all social development and it is pivotal to human social communication through lifespan (Adamson, 1995; Moore, 2012; Mundy, 2016; Shockley, Richardson, & Dale, 2009). A the same time, this influence of joint attention on language development happens to be a bidirectional relationship and these two dimensions mutually reinforce one another (Adamson et al., 2019). Displaying adequate joint attention facilitates language acquisition and having the ability to communicate through words increases the quality of joint attention (Gong & Shuai, 2012).

3. 4. Early social communication and theory of mind.

Joint attention plays an important role as one of the seeds for the growth of social cognition, understood as the ability to comprehend the thoughts, beliefs, intentions, and emotions that guide another person's behaviour (Pellicano, 2010). Research reveals that joint attention and

social cognition seem to belong to the same continuum in development (Mundy, 2016).

Baron-Cohen (1995) defines **social cognition** as a set of cognitive modules which include: (1) a facility which detects intentionality, (2) a facility which detects eye direction, and (3) a combination on these two previous facilities which form the shared attention mechanism. This latter module is what we call joint attention and it seems to result from the combination of *eye direction* and *intentionality*.

This ability of social cognition is frequently named with the name of *Theory of Mind* (ToM) (Leslie, 1987) because it refers to the ability of being able to think about the content of other's minds and understanding their intentions. Situations of ToM are frequent when two people focus on the same event. The fact that ToM habitually occurs as common attention towards the same event is where we see the direct connection between the theory of mind and the abilities of joint attention. ToM requires that we consider the representations of others —*other-referenced information*—, but to do that we need to have *self-referenced information* cognitively available. When we think about someone else's perspective, we must start from our own perspective, our own observations and our own mental representation of what the other person has attended. That is, we must attend the representations of the other person's event and our own representation of the other person paying attention to the event. Moreover, in order to be successful with ToM, the individual must

consider these two layers of information independently in order to separate our own experience from the other's experience an encode them separately (Leslie, 1987).

All this cognitive work takes shape in the capacity of displaying joint attention. It seems that joint attention abilities are necessary for ToM to occur, and Charman et al. (2000) reported about that in their work where associations between IJAL at 20 months old and theory of mind development at 44 months old were found. Joint attention impairments tend to lead to difficulties in social cognition and, at the same time, social cognition disturbances explain joint attention difficulties in children with ASD (Baron-Cohen, 1989). Just as we see children with autism having difficulties with joint attention, they also find extremely challenging those situations which involve ToM (Mundy, 2016).

Other paths to examine the association between joint attention and theory of mind is through measurements of what is known as "mentalizing vocabulary", the use of terms like *think*, *know*, *guess*, or *believe*, to name some. When children refer to mental state terms, this constitutes an eminent marker of growing understanding of the others´ mind (Barreto, Osório, & Baptista, 2018). Several researches have explored the relationship between the use of these terms and joint attention, and the conclusions are definitively diverse. Some authors report about the relationship between IBRH and the use of mentalizing terms (Kühn-Popp, Kristen, Paulus, Meinhardt, & Sodian, 2015), while

others claim that IJAH is a better predictor than IBRH for mental state terms (Camaioni, Perucchini, Bellagamba, & Folonnesi, 2004). Lastly, other authors suggests that it is RJA which is more significantly related to productive mentalizing vocabulary and theory of mind (Abreu, Cardoso-Martins, & Barbosa, 2014; Brooks & Meltzoff, 2002; Kristen, Sodian, Thoermer, & Perst, 2011).

As we can see, the conclusions regarding the associations between ESC abilities in early infancy and theory of mind in preschool ages are still varied, and the strength of these associations are modest (Mundy, 2016). Nevertheless, the interest in studying these associations is latent and the need for future research regarding this issue seem opportune.

3. 5. The neural network of early social communication.

As mentioned, early social communication skills are integrated and can be explained from a paradigm of parallel and distributed processing (PDPM) (Mundy et al., 2009). These skills involve parallel processing of information about self, about others and about a third entity (an object or an event), in conjunction of distributed processing across an anterior cortical system and a posterior cortical system. These two systems would constitute the overall neural network of joint attention. Generally speaking, the anterior cortical system is in charge of self-monitoring and goal-directed actions, and that is why it is normally

related to more volitional attention activities. On the other hand, the posterior cortical system is connected to more involuntary attention activities and it runs the information processing about others and their behaviour (Mundy, 2016; Vaughan Van Hecke et al., 2007). Thus, it has been hypothesised that the posterior system is responsible for RJA, whilst the anterior system is in charge of IJA (Mundy, 2018; Vaughan Van Hecke et al., 2007). The setting of this general mapping has been evidenced using imaging data around 5 months of age (Elison et al., 2013).

However, subsequent data has reframed this general model and new findings have been pointing to new directions. Displaying the complex skill of triadic communication requires the activation of a widely distributed system connected to different functions, which involve the prefrontal, insula, cingulate, temporal, and parietal cortices (Mundy, 2016). These preliminary models are now replaced by a more comprehensive model of neural systems of joint attention, which include the activation of (1) posterior cortical areas (temporal-precuneous-superior colliculus and amygdala), for the processing of other's attention and behaviour; and (2) rostral-medial-frontal (Brodmann's area [BA] 8-9, anterior cingulate, and insula cortex), for the processing of internal state and one's active vision (Mundy et al., 2009; Senju & Johnson, 2009). In addition to that, this new perspective assumes that neural networks that repeatedly activate together become associated, such that the activity in one area often triggers

activity in the other. Integrated rostral-medial-frontal processing of information about self-produced visual attention and parietal-temporal processing of information about others become linked and work together to process joint attention (Eggebrecht et al., 2017; Mundy, 2003).

If we explore some the main ESC skills that have been accompanying us throughout this work, we must highlight how RJA behaviours have been related to activity in the left middle upper frontal cortex in young toddlers (Grossmann & Johnson, 2010). Besides, it has been examined how fronto-temporal connectivity through the uncinate fasciculus in 6-months-old infants is associated with RJA at 9-10 months old (Elison et al., 2013). This uncinate fasciculus is a white matter pathway that involves the inferior medial temporal lobe, the rostral temporal pole (which includes the amygdala), the frontoinsular cortex, and the orbital and ventral medial prefrontal cortex (Mundy, 2003; Mundy & Jarrold, 2010). Regarding IJA, and being that this is the side of joint attention with the most volitional charge compared to RJA, it is reasonable that it draws activation to those areas related to reward (Gordon et al., 2013; Schilbach et al., 2010). Furthermore, the joint attention system also overlaps in some areas with the cortical regions involved in mentalizing or theory of mind (Mundy, 2018; Schilbach et al., 2010).

As we can see, neural systems of triadic communication are widely distributed across the brain and are connected to numerous functions. These neural systems of joint attention continue to differentiate from infancy through adolescence and adulthood (Gordon et al., 2013; Mundy, 2018; Redcay et al., 2012) (see figure 12).

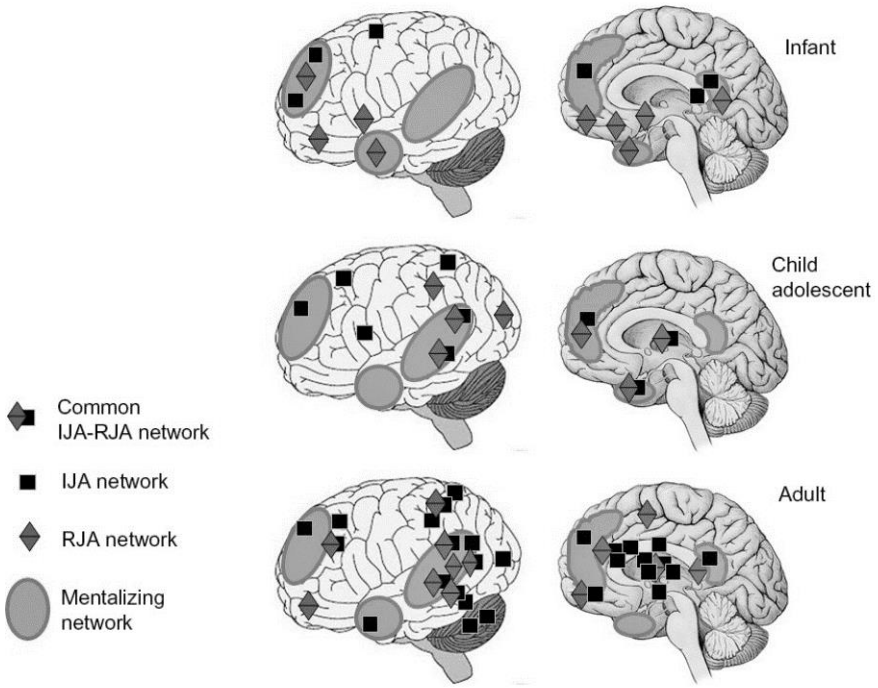

Figure 12. Illustration of observations of the neural systems involved in IJA and RJA development in infancy, adolescence and adulthood. Recovered from Mundy (2018, p. 8).

CHAPTER 4: Early social communication in autistic development and early identification of ASD.

Once we have defined the different behaviours included under the label of *early social communication abilities* and having explored their pivotal role in social-cognitive development, this section aims to present how these communication skills are especially relevant for individuals with ASD. Early differences in joint attention and behavioural request are fundamental to future social learnings (Bruner, 1995; Mundy, 2016), and are even more significant for children with autism, knowing that early interventions targeting joint attention seem to be showing great results when training these children on social performance (Patten & Watson, 2011; White et al., 2011).

In this Chapter we will present the most reported ESC impairments that children with ASD frequently show, and how these may work as early signs for the disorder. Some of them have already been briefly exposed in previous sections. In this case, we aim to gather all these different mentions included in previous sections, extend on them and include other findings that help to provide the complete picture for the impairments of ESC in infants with ASD.

4. 1. The role of early social communication abilities in socio-cognitive development in autism.

Variabilities in joint attention skills are especially important for individuals with ASD. The amount of effort needed to engage and maintain joint attention differs across children with ASD and that may contribute to heterogeneity in syndrome manifestations. The extent to which children with ASD participate in triadic communication often depends on motivation. It has been hypothesised that children with ASD display lower levels of joint attention than children with typical development due to the feeble motivation that frequently they exhibit when having to engage in social situations (Chevallier et al., 2012). It seems to be the case that they find object exploration more appealing than social interaction. Thus, the object-oriented reward system may reside behind their dispersed desire to participate in people-oriented activities (Chevallier et al., 2012; Kim et al., 2014; Lee & Schertz, 2019; McCleery et al., 2009; Moriuchi et al., 2016).

In addition to that, we must consider that this same system could also be operating to regulate their lower motivation to be the object of other's attention (Mundy, 2016). This low motivation for social interaction and joint attention may have substantial implications if we consider the following situation. Based on the importance of joint attention in later social-cognitive development and learning (Kim & Mundy, 2012; Mundy & Newell, 2007; Mundy & Sigman, 2006; Redcay

et al., 2012; Schilbach et al., 2010), these children, with lower previous motivation to participate in social interactions will be less likely to display IJA and this will most likely have an attenuating effect in later social development and specially in language acquisition (Thorup et al., 2018).

Having good joint attention abilities seems to work as a powerful catapult for important developmental milestones like language learning to someone with difficulties in social performance (Bono, Daley, & Sigman, 2004; Toth, Munson, Meltzoff, & Dawson, 2006; Van der Pelt, Warreyn, & Roeyers, 2014). Those children with better willingness and capacities for joint attention, will be able to take more advantage of those situations where word association occurs and therefore advancing in their language development (Luyster, Kadlec, Carter, & Tager-Flusberg, 2008). On the other hand, those children with poorer joint attention abilities will be more likely to exhibit language disturbances in those cases where language emerges. Differences in joint attention during early childhood have been linked to differences in linguistic skills later in development in children with autism (Ibáñez et al., 2013; Mundy et al., 1990; Parlade & Iverson, 2015). It seems that IJA and RJA measures are both linked to **expressive language** but only RJA performance predicts **receptive language** in children with ASD (Luyster & Lord, 2010; Maljaars, Noens, Scholte, & van Berckelaer-Onnes, 2012; Thurm, Lord, Lee, & Newschaffer, 2007). Contrary, different authors claim that RJA is indeed related to expressive

language in samples of children with ASD, but IJA is unrelated to expressive linguistic skills (Adamson et al., 2019; Bottema-Beutel, 2016).

Nevertheless, it is frequent to read that language learning via joint attention in children with ASD is less common due to the fact that children with autism tend to display less of this type of declarative communicative acts (Yoder & Lieberman, 2008). Many studies have reported the association between joint attention (declarative communication) and language in typical development, but less has been reported about the imperative side of joint attention (behavioural request) and its relation to language development (Colonnesi et al., 2010; Salo et al., 2018). We can expect that joint attention is strongly related to language development based on the assumption that the child is eager to interact socially in communication. But behavioural request, which is fundamentally driven for imperative purposes, does not motivate the same type of communication. In the same way, the association between declarative communication and language learning has been more broadly studied and identified in autistic development. The few researches conducted to explore the associations between imperative use of early communication and language development seem to converge in the lack of statistical significance of the associations (Harbison et al., 2017). Continued investigation to shed more light on this issue is indispensable.

Regarding the associations between ESC and other aspects of social development, be it Theory of Mind or intention understanding, RJA measurements at 2 years old have been reported to be associated to these social processing in samples of infants diagnosed with ASD (Schietecatte, Roeyers, & Warreyn, 2012). These abilities constitute a solid basis for subsequent social development in a disorder where the deterioration of social skills is one of its main characteristics.

Joint attention impairments may also be behind the difficulties that many students with ASD have in reading comprehension (Mundy, 2016). Text comprehension requires that the reader —the receiver of information— adopts a common frame of reference with the writer of the text —the sender of information—. Writer and reader must share the same reference, this is, the text and the information the text refers to. In other words, joint attention is required so that the message can be transmitted and text comprehension can occur. That is why joint attention impairments is one of the explanations that have been given to the difficulties in reading comprehension in children with ASD (Estes, Rivera, Bryan, Cali, & Dawson, 2011; Jones et al., 2009), together with the difficulties that often individuals with ASD have with attention management and the presence of comorbid ADHD symptoms (Singzig et al., 2008). At the same time, differences in reading comprehension often explain part of the variability in the social phenotype of ASD (Estes et al., 2011).

In the same way, impairments in cooperative behaviour observed in children with ASD may be explained partly by disturbances in joint attention (Colombi et al., 2009). Some researchers have pointed out how the disposition of children with ASD to cooperate is strongly linked to their abilities to mutate and to exhibit joint attention (Colombi et al., 2009; Downs & Smith, 2004; Hill & Sally, 2003; Kaartinen et al., 2019). The ability to cooperate develops out of the capacity to understand the intentions of the other people and the capacity to share these intentions and experiences. In these sharing of intentions is where the link between joint attention and cooperative behaviour resides (Colombi et al., 2009). According to Hill and Sally (2003), children with autism exhibit impairments in cooperative behaviour because they have severe difficulties understanding the intentions of others, but Tomasello et al. (2005) claim that these impairments do not reside so much in their difficulties with understanding the intentions of others but in their inability in sharing these intentions with others.

Finally, joint attention abilities are also related to imitation in children with ASD (Vivanti & Dissanayake, 2014). Imitation skills are a kind of abilities which can be stimulated in the context of joint attention, and specially infants with autism can benefit from it (Ezell et al., 2011; Ingersoll, 2012; Ingersoll & Schreibman, 2006). Imitation increases the awareness of being the object of other's social attention and that can be the perfect scenario for interventions which aim to train joint attention and enhance social abilities in individuals with

difficulties in these areas (Edwards, Stephenson, Dalmaso, & Bayliss, 2013; Reddy, 2003). In fact, joint attention skills before treatment have a strong influence on the prediction of the success of this intervention (Yoder & Stone, 2006). Those children with ASD who display IJA behaviours prior to the intervention are more likely to better their accomplishments in social outcomes. This can be due to the fact that they can use these joint attention abilities as pillars to train other social skills (Schertz & Odom, 2007; Schertz et al., 2013). It appears that children with ASD who display better joint attention abilities, show greater language improvements after going through the proper intervention (Bono et al., 2004).

All in all, it is visible how research have connected joint attention abilities to different linguistic outcomes in children with ASD (Toth et al., 2006). However, conclusions are not always conclusive in regards to which communicative behaviours connect with which developmental social skill. Continuing to enlarge research around this issue is fundamental. ESC skills are extremely influential in crucial aspects of social development like language acquisition in typical development. And these same skills are a fundamental pillar which is present across the lifespan. So it is reasonable that impairments in joint attention have an impact on language development and social competence beyond infancy in individuals with ASD (Gillespie-Lynch, Elias, Escudero, Hutman, & Johnson, 2012; Moore, 2012). Finally, differences in joint attention are extremely important in children with autism because they

seem to be related to the severity of the symptoms (Gulsrud, Kasari, Freeman, & Paparella, 2014).

4. 2. Early social communication impairments and early signs of autism.

ASD diagnosis often occurs during or after preschool years (Howlin & Moore, 1997; Shattuck, Durkin, & Maenner, 2009; Wiggins, Baio, & Rice, 2006). Being able to establish a definitive diagnosis before 2-3 years of age is difficult due to the changeability of infant development, and because of the variety of disorders that may be linked to the same early impairments (Chakrabarti & Fombonne, 2005; Daniels & Mandell, 2014; Ozonoff et al., 2010; Zwaigenbaum et al., 2013, 2015). Even though the DSM-5 (American Psychiatric Association, 2013) has facilitated the task of referring to specific clinical pathognomonic when defining autism, the newest versions of the manual continues to have difficulties in defining what these indicators are before 2 years of age (Johnson, 2008). Delayed identification of ASD means that the intervention that may possibly be applied cannot be called "early" anymore (Turner-Brown et al., 2013). Early intervention is important because it occurs during an wonderful stage in infant development when the window of neurological plasticity is open (Dawson, 2008), allowing the possibility of inducing permanent changes in physiology and promoting the development of important pivotal skills that are foundational for social relationships, academic success, and

independence later in life (Turner-Brown et al., 2013; Twyman et al., 2009).

Caregivers are still the very first reporters of early difficulties in very young children (Bolton, Golding, Emond, & Steer, 2012; Johnson, 2008; Richards, Mossey, & Robins, 2016; Schanding, Nowell, & Goin-Kochel, 2012). Parents of children diagnosed with ASD habitually report having recognized symptoms around 2 years old in some cases —this is applicable for parents of children with ASD who tend to be more passive in social interaction and, hence, whose symptoms are more recognisable. The average age when parents of children with ASD with more active patterns report about the first symptoms is 4 years old— (Mundy, 2016). However, research has showed that it is possible to observe early signs at earlier ages. The findings are inconsistent when trying to identify signs before 6 months of age, since early signs are as likely to be sensitive to risk for ASD as they are for DD risk, and results in that sense must be interpreted with caution (Brewe, Reisinger, Adlof, & Roberts, 2018; Landa, Gross, Stuart, & Faherty, 2013; Landa, Holman, & Garrett-Mayer, 2007; Mundy, 2016; Ozonoff et al., 2010; Rogers, 2009; Rozga et al., 2011). Consistent behavioural markers begin to be recognisable only **after the first birthday** (Jones, Gliga, Bedford, Charman, & Johnson, 2014; Mundy, 2016; Zwaigenbaum et al., 2013). Many of the infants who show signs at 14 months old can be reliably diagnosed (Chawarska, Klin, Paul, Macari, & Volkmar, 2009; Guthrie, Swineford, Nottke, & Wetherby, 2013), and around 18 months old,

solid markers of autism are present in most of the cases (Baron-Cohen et al., 1996; Charman, Swettenham, & Baron-Cohen, 1997; Franchini et al., 2019; Johnson, 2008). All in all, it appears that most autistic symptoms emerge during the second year of life (Jones et al., 2014).

The strongest marker of future social communication problems associated with ASD reported so far are impairments in IJA (Franchini et al., 2019; Schertz & Odom, 2007; Schertz et al., 2018). This behavioural marker shows a moderate level of test-retest reliability over 3 months assessment intervals (Mundy, 2016; Mundy et al., 2007), and it has proved to be a significant powerful discriminator against the risk of other developmental disorders (Charman, 2003; Dawson et al., 2004; Hobson & Hobson, 2007; Sigman et al., 1999).

Despite the fact that both IJA and RJA have been related to ASD early symptomatology, it has been reported that alterations in IJA are a better discriminator than a deteriorations in RJA (Charman, 2003; Dawson et al., 2004; Gotham et al., 2007; Hobson & Hobson, 2007; Sigman et al., 1999). This is because early RJA impairments can remit in older children with ASD, and specially in those who start to use some language, but disturbances in IJA tend to be present through the preschool period and also through adolescence (Charman, 2003; Gillespie-Lynch et al., 2012; Mundy, 2016). Gotham et al. (2007) examined data from over 1,000 children with ASD and reported that both RJA and IJA are useful in early diagnostic, when language is not established yet. However, the validity of RJA decreases significantly

when children start to use words, while the validity of IJA tends to remain. Furthermore, some children with ASD and impairments in joint attention, display a decent range of it when encouraged to participate in RJA situations (Bono et al., 2004), and rely on RJA to solve referential ambiguity in word learning (Luyster & Lord, 2010; Norbury, Griffiths, & Nation, 2010). As we can see, some children with ASD may show significant disturbances of joint attention but others may have RJA behaviours that, when displayed in certain situations, seem to resemble the levels observed in typical development (Hani, González-Barrero, & Nadig, 2013; Nation & Penny, 2008). This is not saying that assessment of RJA is not important for the identification of early signs of ASD. Both IJA and RJA disturbances can be observable in young infants and can be an essential marker of risk in preverbal children, but RJA impairments becomes less evident when the child enters preschool (Nation & Penny, 2008). Authors like Yoder, Stone, Walden, and Malesa (2009) have revealed how RJA measures at 14 and 15 months old of age are good indexes for early signs of ASD in infants with initial biological risk, and Ibáñez et al. (2013) claim that these measures can be significant as early as 8 months old.

Another important aspect to be considered when measuring IJA in the context of early markers of ASD, according to some authors, is the possible presence of **positive affect** co-occurring with it. Kasari et al. (1990) found that 60% of the children with typical development displayed IJA in conveyance of positive affect, but this positive affect

co-occurring with IJA was less frequent in children with autism (Gangi et al., 2014). In addition to that, distinctions between *reactive smile* and *anticipatory smile* must be done, because it has been seen how the predictive validity of IJA with positive affect at 8 months old rely on measures of anticipatory more than reactive smile. When the child smiles in response to looking at the face of the adult, this is called **reactive smile**. But if the infant smiles first because he sees the object and then turns to the tester, this is known as **anticipatory smile** (Mundy, 2016). Sometimes we can see how children, regardless of the risk, display IJA with positive affect. In that sense, anticipatory smiling is a better discriminator to identify children at risk than reactive smiling is (Gangi et al., 2014). This is why we must be careful when assessing and considering IJA with affect to establish the risk. It is important to examine cautiously if this affect occurs as a reaction after the adult's gesture or it is the child's initiative and willingness of sharing affect what motivates this behaviour (Gangi et al., 2014; Mundy, 2016). Faced with this situation, authors like Gangi et al. (2014) recognize that, since IJA with smiling occurs at a marked lower frequency than IJA without smiling in children with autism, measures of IJA without smiling end up being a more reliable measure than measures of IJA with smiling. To the present, measures of joint attention are more well supported than measures of joint attention together with affect sharing (Mundy, 2016).

On the other side, measurement of the **trajectory of these ESC behaviours** are of comparable importance to the measurement of the

behaviour itself (Zwaigenbaum et al., 2013). Different authors, such as Ibáñez et al. (2013), Jones and Klin (2013), and Yoder et al. (2009) have explored the power of longitudinal growth ESC measures in groups of at-risk children. These at-risk children are infants who have a higher risk of being diagnosed with ASD because they have one condition which increases their probability of receiving the diagnosis, for instance having a sibling with the disorder or being preterm. This issue will be covered in more detail in Chapter 5. Conclusions regarding this matter have revealed that, although measures of IJA at 8 months can be important to determine the risk for ASD, it is the growth of IJA what can significantly predict those at-risk children who will receive the diagnosis (Ibáñez et al., 2013; Yoder et al., 2009). Typically, joint attention growing trajectories from 9 to 12 months old display a less pronounced rise in this group of vulnerable infant population, compared to infants with typical development, who tend to show rapid progress in these skills (Mundy et al., 2007; Poon et al., 2012). In the same way, other research have shown how growth in joint attention skills from 14 to 24 months old tends to be less pronounced in infants with ASD when compared with infants without ASD (Landa et al., 2007; Macari et al., 2012; Rozga et al., 2011; Yoder et al., 2009). Trajectories are also important when talking about behavioural request. According to Ibáñez et al. (2013), it seems that the starting point for behavioural request is not significantly discriminatory for children at risk but the increase of behavioural request is. At-risk infants' increase of behavioural request

tends to be slower than not-at-risk infants' increase (Ibáñez et al., 2013).

Despite all of this, and although a great amount of literature suggests that many children can show early markers for ASD around 12-14 months of age (Jones et al., 2014; Mundy, 2016; Zwaigenbaum et al., 2013), a considerable number of infants do not exhibit these early signs during this period (Landa et al., 2007; Werner, Dawson, Munson, & Osterling, 2005). Some children later diagnosed with ASD may display behavioural markers that seem confusing or inconclusive, and some of them do not show any signs at 10–12 months of age (Werner et al., 2005). A prospective study by Landa et al. (2007) demonstrated that 46% of infants diagnosed with ASD at 24 months of aged were asymptomatic at 14 months old. According to some authors, we can differentiate two groups of ASD-identified infants in terms of temporality: *early-identified* and *late-identified* (Landa et al., 2013). Early-identified infants start to show clear discrepancies in early communication around 14 months old (Chawarska et al., 2009; Guthrie et al., 2013), but the impairment pattern of late-identified infant is not so apparent until 18 months old and it is more clearly seen only at 24 months old (Landa et al., 2013). In addition to that, we must consider those cases with a regressive onset, when children begin to show symptoms after a period of a generally typical development (Rogers, 2005). Werner & Dawson (2005) report that infants with an autism of regressive onset do indeed display levels of joint attention similar to

those children with typical development during the first year of age, and it is not until 2 years old that the alterations begin to be observable. That is another issue that may be hindering early screening.

All in all, although the different systems of early detection are currently considerably appropriate, we can still expect to miss some children who end up having the disorder (Turner-Brown et al., 2013). The consensus is notably high when placing the difficulties in early social communication in the core of the social impairments in ASD, and in the base for early identification (Franchini et al., 2019; Schertz & Odom, 2007; Schertz et al., 2018). Nevertheless, findings are sometimes non-conclusive and the markers' strength may vary. IJA is claimed as the strongest predictor (Mundy et al., 2007; Thorup et al., 2018), but RJA and IBR trajectories appeal to be decent competitors when identifying early signs of ASD (Ibáñez et al., 2013; Nation & Penny, 2008; Yoder et al., 2009). Findings are not definite regarding the moment in development where indicators are significant, with some authors claiming that early signs can be observed as early as 8 months of age in some children (Ibáñez et al., 2013; Mundy, 2016; Veness, Prior, Eadie, Bavin, & Reilly, 2014) and others nuancing that these early signs can never be completely clear until 18 months old (Baron-Cohen et al., 1996; Charman et al., 1997; Franchini et al., 2019; Johnson, 2008). Some authors like Gangi et al. (2014) or Landa et al. (2013) advice to proceed with caution when considering IJA measures as undisputed indicator of high risk for ASD, especially at very young ages

(Brewe et al., 2018). Research is still young and further work is indispensable to progressively untangle the inquires surrounding early markers and early identification of ASD.

Finally, there is something that must be contemplated carefully in the context of identification of early behavioural markers for ASD. Traditionally, it was considered that the social characteristics in autism were equal to a "lack of responsiveness to others" (Mundy, 2019). But actually this idea cannot be further from reality. Many people with autism do respond to social invitation in certain situations where they are given specific support to do so (Clark & Rutter, 1981; Lord, 1984), they many times respond and learn from the actions of others (Charlop, Schreibman, & Tryon, 1983) and are aware when others imitate their actions (Dawson & Adams, 1984). Moreover, many children with autism show typical responses during separation and reunion with their caregivers, which provide evidence of the existence of attachment (Sigman & Mundy, 1986). People with autism do not always avoid social contact and are not always clueless in social situations.

Wing and Gould (1979) distinguished between three groups of social behaviours in people with autism: (1) Some children with autism are **socially aloof**, more like the classical definition of autism and social avoidance or repellence and non-responsiveness. Often these cases are so because they tend to be accompanied by intellectual disabilities. (2) Other children with autism tend to be more **passive**, but can participate in social interactions when they meet certain features like structured

situations. Some individuals with higher-functioning ASD can manage to participate in interactions if they have specific information about the situation and after having learnt some strategies about how to proceed in social situations (Sato et al., 2010). Finally, (3) a third group of children with autism is characterized by individuals who do **seek social interaction** but frequently these interactions turn out outrageous or anomalous. This variability regarding ASD manifestations are nowadays broadly accepted and that was partly thanks to Wing and Gould (1979) who first suggested the consideration of autism as a *spectrum*.

This idea was worth mentioning because, when assessing early social communication abilities for the identification of early signs of ASD, it is important to know that the markers that we are trying to find are not going to be as easy identifiable as simply a behaviour being inexistent. This is, the early social communication profile of the infants who receive the diagnosis of ASD is not totally absent (Mundy, 2019). Infants who meet the criterion for being classified as at-risk for showing early signs do certainly communicate and do certainly use early social communication. Again, when measuring impairments in this area, we must look further than the **absence/presence** dichotomy**,** and observe carefully the nuances of the type of interactions children display (Bedford et al., 2012). Thus, measures like *frequency* of *mode* of the different behaviours that form the social communication abilities are much more informative than measures of mere absence/presence (Franchini et al., 2019). The consideration for the risk can never be

dependent on social behaviours being present or absent, but frequency and mode of appearance of social responses should be reported (Watson et al., 2013).

In closing, assessing ESC abilities and learning more about early social communication, and especially about joint attention, during pre-speech stages is essential to know more about the early expressions of autism. Evaluating these abilities during the first months of development can give us crucial information about the presence of first symptoms of ASD and about the identification of the risk (Franchini et al., 2019; Johnson, 2008; Mundy, 2016; Thorup et al., 2018). These early evaluations should never rely on dichotomy methods of presence/absence of behaviour, but they should be specially meticulous and consider other things like what type of communication is the child showing or the frequency of the behaviours the child is displaying (Watson et al., 2013).

CHAPTER 5: At-risk population and early detection in childhood care services.

5. 1. Infant population with higher risk of autism.

If we revise the numbers, 13% of 9-month-old children have some form of DD. Among this population with developmental delays, 10% of them hold the risk of being diagnosed with ASD (Rosemberg, Zhang, & Robinson, 2008). But sometimes non-clinical general population can display traits of autism too, regardless of eventually receiving any ASD diagnosis. This is what we call at-risk population. These so-called traits of autism are features that could be classified under the label of ASD but are not persistent or strong enough to be considered diagnosable (Mundy, 2016).

Why do we want to know about at-risk population? Working with at-risk children gives us the opportunity to learn more about how early signs of ASD emerge and develop, and exploring how these signs show and evolve in this more vulnerable population can contribute notably to the elucidation of the timing in the first manifestations of ASD (Mundy, 2016; Rogers et al., 2014). The two biggest groups of at-risk infant population that have been constituting the samples of recent research in that regard are siblings of infants with ASD and preterm children.

5. 1. 1. Siblings of children with autism.

The estimated prevalence of ASD in Spain known to date is 1.55% in pre-schoolers and 1% in school children (see for a review Málaga et al., 2019; Morales Hidalgo, 2018).

This number is even higher in the case of siblings of people with ASD (sib-ASD). Having a sibling with ASD increases the possibility of having related symptomatology and receiving the diagnosis. Between 5 and 10% of sib-ASD are also diagnosed with the same disorder (Cassel et al., 2007; Constantino, Zhang, Frazier, Abbacchi, & Law, 2010). Others authors have suggested that 18.7% of sib-ASD are diagnosed with the same disorder (Ozonoff et al., 2011). And some research have pointed out that this number goes up to 20% (Elsabbagh & Johnson, 2010). That is why this infant population is considered at-risk population.

But having a sibling with ASD does not necessarily mean having the disorder. Nevertheless, some studies have observed that certain autistic traits are somewhat more frequent in this at-risk population, regardless of receiving the diagnosis (Cornew, Dobkins, Akshoomoff, McCleery, & Carver, 2012). This set of traits include weaker eye contact with the adult, fewer episodes of social interaction with smile, less anticipatory smile when displaying joint attention (Cassel et al., 2007; Filliter et al., 2015; Gangi et al., 2014; Key et al., 2015), less use of gestures to communicate (Mitchell et al., 2006; Presmanes, Walden, Stone, & Yoder, 2007; Stone, McMahon, Yoder, & Walden, 2007), lower

IJA, RJA and IBRH from 12 to 18 months old (Cassel et al., 2007), weaker presence of RJAP (Presmanes et al., 2007), lower IJAL at 10 months (Thorup et al., 2018), and language delays (Messinger et al., 2013; Toth, Dawson, Meltzoff, Greenson, & Fein, 2007). This profile of autistic-like communication traits, known by the name of *Broader Autism Phenotype* (BAP) (Goldberg et al., 2005), can be observed in this group of high-risk children in a prevalence that is estimated of 25% (Pisula & Ziegart-Sadowska, 2015; Walton & Ingersoll, 2015). In sum, an early communication profile defined by some mild difficulties in social interaction which are not strong enough to fall into the category of an ASD diagnosis but result in a set of social difficulties that sometimes can affect the way relationships are experienced, with scores that often lie on an intermediate position between children with ASD and siblings of typically developing children. This population of individuals with BAP constitute population at risk and require as attention as those individuals who are diagnosed (Pisula & Ziegart-Sadowska, 2015; Walton & Ingersoll, 2015).

However, some authors aim to specify that these difficulties in communication are not characteristic of sib-ASD as a homogeneous group, but are present *only* among those siblings that are later diagnosed (Ibáñez et al., 2013; Rozga et al., 2011). Sib-ASD who do not receive the diagnosis do not always show those difficulties (Gillespie-Lynch et al., 2015; Rozga et al., 2011). The remarkable findings of Sullivan et al. (2007) with respect to the RJA among ASD-sib show

different results for those brothers who receive the diagnosis and for those who do not. According to these authors, general measures of RJA tend to be low in ASD siblings as a group at 14 months of age. But if we focus on the results in these same measures when we divide the group of sib-ASD between those who receive the diagnosis and those who do not, the majority of ASD-positive siblings have major difficulties with RJAD. On the other hand, this is not the case for the ASD-negative siblings, who obtain scores of RJAD closer to those siblings of children with typical development. Curiously, that measure which Presmanes et al. (2007) claimed to be central in identifying early markers in sib-ADS, RJAP, is not what Sullivan et al. (2007) claimed to be the core measure to identify these early markers, RJAD.

In the same line, figure 13 illustrates the results of an impressive work conducted by Ibáñez et al. in (2013) with a sample of children classified in three groups: (1) "All High-Risk Siblings", this is, children who have a sibling with ASD and, therfore, are at-risk infant pupulation; (2) "Low-Risk Siblings", this is, children with a tipically developing sibling and, therefore, low-risk infant population; and (3) "High-Risk Siblings without ASD", this is, at-risk children who did not end up with the diagnosis. We can see how the scores for the Low-Risk group are the highests, the scores for the All High-Risk group are the lowest, and the scores for the High-Risk Siblings without ASD lies on an intermediate position between children with ASD and Low-Risk Siblings. In addition to that, this figure is specially remarkable since it also illustrates the

differences in growth patterns among the several early social communicative behaviours mentioned in 2. 1. 1. of Chapter 2. Panels *a* and *c* show the linear growth pattern of RJA and IBR, while panel *b*

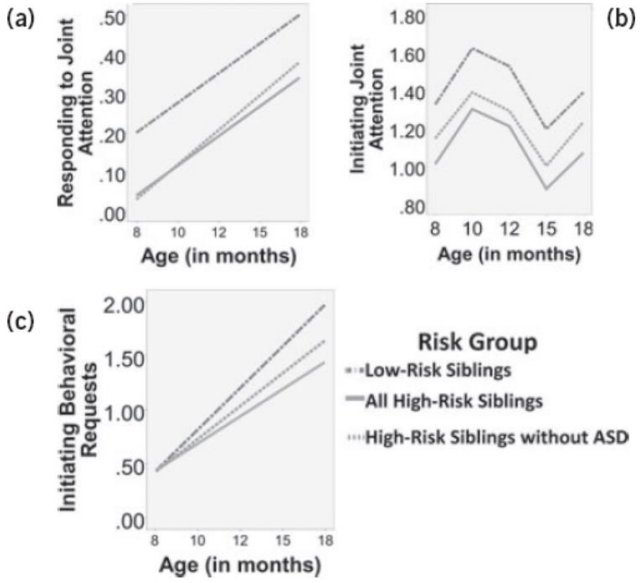

Figure 13. Illustration of the growth curves of RJA (a), IJA (b), and IBR (c) in low-risk and at-risk infants. Recovered from Mundy (2016, p. 69) with permission. From Ibáñez et al. (2003).

illustrates the nonlinear cubic pattern of growth which characterizes IJA development in all groups of at-risk and low-risk children. This idea of the non-linear growth present in IJA was mentioned in section 2. 1. 1. of Chapter 2.

As we can see, the field of searching of ASD early signs in sib-ASD is still conflicting and a firm consensus has not yet been reached.

Different research point to different measures, and different conclusions bring us to different corners. Nonetheless, the study of early ASD signs with siblings is a field of a great richness for the identification of early markers. Conducting longitudinal research with this at-risk population can give us an extremely valuable picture of where to look at when searching for early ASD signs in the general population (Thorup et al., 2018; Zwaigenbaum et al., 2009). In addition to that, we must consider that we are talking about an infant population with a vulnerability, who sometimes display social difficulties when relating to others and to the world, and that makes them as worthy of our attention as those children with the diagnosis. Sib-ASD can be targets for early interventions as much as children without the added vulnerability who are showing first signs. Intervening early has shown to be successful, even before a formal ASD diagnosis (Brian, Smith, Zwaigenbaum, & Bryson, 2017; Brian, Smith, Zwaigenbaum, Roberts, & Bryson, 2016; Rogers et al., 2012, 2014).

5. 1. 2. Preterm infants.

Literature indicates that prematurity accounts for the 10-15% of cases of diagnosis of ASD in the USA (Schieve et al., 2016). In addition to that, if prematurity is accompanied by low birth weight, the risk of developing autistic features and ending up with a diagnosis increases (Schieve et al., 2016; Williamson & Jakobson, 2014). Even in those late-premature children, whose initial risk is expected to be lower, it is

observed that they sometimes present communication difficulties at 18 and 36 months (Stene-Larsen et al., 2014), regardless of finally receiving the diagnosis. It is still to be clarified what is the role of prematurity in predicting the risk of ASD in the future.

As mentioned, it appears that some preterm population can present certain social and communication deficits not necessarily linked to a clinic diagnostic (Stene-Larsen et al., 2014). Knowing what we know about ASD early signs observable during the first two years of life, there is the possibility of mistakenly considering these deficits as early ASD signs, which would lead to an identification of false positives (Guy et al., 2015; Verhaeghe et al., 2016). According to Yaari et al. (2016), in a typical evaluation of early markers at 8 months of life, 21% of preterm infants would present ASD early symptomatology. These values are 9% if the evaluation is at 12 months. This high prevalence of false positives among preterm population could be explained by the existence of what is known as the "*Preterm Behavioural Phenotype*" (Johnson & Marlow, 2011). This *phenotype* refers to a profile of alterations which derive from the premature birth and could be confused with early ASD manifestations. These alterations can be present in areas such as social interaction, language, attention, sensory processing and motor control. The *Preterm Behavioural Phenotype* is more frequent among the group of extremely preterm without motor, visual or auditory problems, than in the late preterm and at-term children (Yaari et al., 2016). Therefore, a diagnosis of ASD (or risk of

ASD) should be performed with extreme caution with this population, even if we can identify early social deficits. These deficits could be occurring because of the preterm behavioural phenotype.

Regardless of having the diagnosis, children born prematurely frequently have a greater risk of presenting deficits in social relations and communication abilities, and that makes this infant population also needy for our attention. As mention in the section above, early intervention has proven to be effective, even before a formal ASD diagnosis has been made (Brian et al., 2016; 2017; Rogers et al., 2012; 2014).

5. 2. Early detection in childhood care services.

As mentioned in previous sections, ASD diagnosis typically occurs during the preschool years, and it rarely occurs before 2 years of age (Chakrabarti & Fombonne, 2005; Howlin & Moore, 1997; Johnson, 2008; Shattuck et al., 2009; Wiggins et al., 2006). The average age of ASD diagnosis is typically after the fourth birthday (Rhoades, Scarpa, & Salley, 2007). With delayed identification, professionals are missing the opportunity of approaching disturbances early on in development (Daniels & Mandell, 2002), which would allow the proper intervention to offer appropriate skills to a child who will be able to broader his independence later in life. Effective methods for early detection of ASD

risk are imperiously needed (Turner-Brown et al., 2013; Zwaigenbaum et al., 2013).

The *American Academy of Pediatrics* (AAP) recognizes the need for earlier identification and recommends that paediatricians conduct ASD screening at children's 18- and 24-month visits (Johnson & Myers, 2007). Diagnostic manuals such as DSM-IV (American Psychiatric Association, 1994) or DSM-5 (American Psychiatric Association, 2013), include criteria like "communication skills deficit", "language difficulties/atypical language" or "minimal success in establishing satisfactory friendship with peers". Nonetheless, these indicators are applicable for ages exceeding the first months of life, when detection is not *early* anymore (Johnson, 2008).

Parental concerns are the first indicators for early risk consideration (Schanding et al., 2012), although the role of regular paediatric care is essential to confirm it. Physicians are the first professionals who families encounter when a child is born, and they have the best opportunity to follow the child's early development closely, be aware of any early sign and promptly report to parents or to other professionals. In that sense, paediatricians' knowledge about ESC would contribute enormously to early detection of ASD (Channa, Lee, & Kasari, 2019).

Previous research assert that the average time it takes to make a definitive diagnosis of ASD is around 15.5 months, as shown in a study

by Shevell, Majnemer, Rosenbaum, and Abrahamowicz (2001). This could be due to the lack of awareness with respect to early signs of ASD that sometimes exists among practitioners and other childhood professionals, and the fact that often the main focus of child care professionals are possibly other medical concerns which may mask ASD identifiers (Channa et al., 2019). Alternatively to this possible explanation, there is also the fact that paediatricians sometimes tend to adopt a more "wait and see" approach (Daniels & Mandell, 2002). This highlights the need for paediatricians to take parent concerns seriously during the referral and reduce the times of the diagnostic processes (Rhoades et al., 2007; Richards et al., 2016; Sacrey et al., 2018). Some studies have revealed that a noteworthy delay exists between when parents first become concerned about their child's development to when the child ultimately receives an ASD diagnosis (Moh & Magiati, 2012; Siklos & Kerns, 2007).

On another note, teachers' collaboration would also be of great value in early screening and ASD detection. Involvement of teachers in school-based ASD evaluations can be an excellent method since preschool teachers have the opportunity to observe a potentially bigger amount of children throughout different moments of a day. Particularly if the early signs have not been identified before the child enters preschool, it is essential for teachers to be especially sensible to the signs and use effective tools for screening when the first markers begin to manifest (Schanding et al., 2012). Having the collaboration of the

different agents to identify early ASD markers can be extremely beneficial base on the idea that a variety of informants can observe the child in different contexts (Moh & Magiati, 2012; Ozonoff, Goodlin-Jones, & Solomon, 2005; Sacrey et al., 2018; Schanding et al., 2012).

In conclusion, it seems that when collaboration among the health-care system, the educational contexts, and caregivers occurs, a number of potential gains can be obtained (Daniels & Mandell, 2002). Efforts to enhance health professionals' knowledge about parental concern, and about ESC and early ASD signs (Channa et al., 2019), as well as efforts to approximate appropriate screening to teachers, have the potential to result in an earlier diagnosis and earlier interventions, with the subsequent benefits that may arise (Daniels & Mandell, 2002).

CHAPTER 6: Metodologia

6. 1. Disseny

Aquest és un estudi de cohort longitudinal prospectiu amb una mostra de 55 bebès i les seues famílies i tres moments d'avaluació –8 mesos, 12 mesos i 18 mesos d'edat–. Inclou tant objectius longitudinals com objectius transversals. Les edats en els tres moments d'avaluació han sigut aproximades, amb moments d'avaluació que se situen entre els 8 i els 10 mesos (*M* = 8.22; *DT* = 0.55) per a la primera avaluació, entre els 12 i els 13 mesos (*M* = 12.07; *DT* = 0.25) per a la segona i entre els 18 i els 20 mesos (*M* = 18.23; *DT* = 0.57) per a la tercera. D'ara endavant, direm 8 mesos, 12 mesos i 18 mesos per a referir-nos als tres moments d'avaluació: 8-10 mesos, 12-14 mesos i 18-20 mesos, respectivament.

6. 2. Objectius

L'*objectiu principal* del present treball és avaluar les habilitats de comunicació social primerenca en una mostra de xiquets nascuts a la província de València en tres moments evolutius (8, 12 i 18 mesos), per tal d'explorar si aquestes habilitats en els moments evolutius més primerencs es relacionen amb les habilitats del llenguatge en els posteriors moments evolutius, i amb la presència de primers marcadors de TEA als 12 mesos i als 18 mesos.

Els *objectius específics* són:

1. Analitzar com es relacionen les distintes habilitats de comunicació social primerenca en cadascun del tres moments evolutius (8, 12 i 18 mesos), en una mostra de xiquets nascuts a la província de València.

2. Analitzar l'evolució de les distintes habilitats de comunicació social primerenca a través dels tres moments evolutius (8, 12 i 18 mesos), en un grup de xiquets nascuts a la província de València.

3. Analitzar la capacitat predictiva de les habilitats de comunicació social primerenca als 8 mesos sobre els marcadors primerencs de TEA als 12 mesos, en un grup de xiquets nascuts a la província de València.

4. Analitzar la capacitat predictiva de les habilitats de comunicació social primerenca als 8 i als 12 mesos sobre la presència de primers marcadors de TEA als 18 mesos, en un grup de xiquets nascuts a la província de València.

5. Explorar la relació entre les habilitats de comunicació social primerenca als 8 mesos amb la competència lingüística als 12 mesos, i la relació entre les habilitats de comunicació social primerenca als 8 i als 12 mesos amb la competència lingüística als 18 mesos.

6. 3. Model conceptual

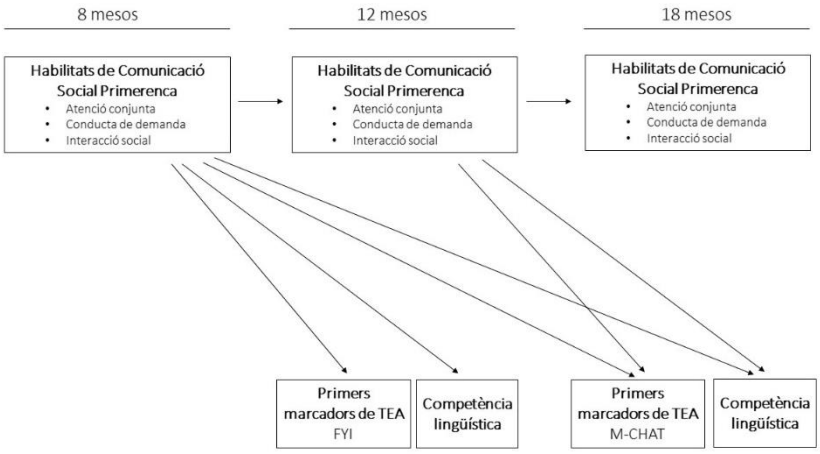

Figure 14. Conceptual model.

El model conceptual il·lustra l'objectiu principal de l'estudi, el qual es vincula a la següent pregunta d'investigació que articula el present treball: *"Quina és la relació entre les habilitats de comunicació social primerenca als 8 i als 12 mesos, les habilitats del llenguatge als 12 i als 18 mesos i els primers signes de TEA als 12 i als 18 mesos?"*

Les tres etiquetes de la part superior de la imatge —"8 mesos", "12 mesos" i "18 mesos" — representen el caràcter longitudinal de l'estudi, amb els tres moments evolutius representats en tres columnes verticals. Cada casella està situada dintre de la columna que li pertoca atenent al moment en què el constructe ha estat avaluat. S'han avaluat les habilitats de comunicació social primerenca en els tres moments,

els signes primerencs de TEA als 12 i als 18 mesos i les habilitats del llenguatge als 12 i als 18 mesos.

A la casella d'habilitats de comunicació social primerenca s'especifica que s'han mesurat aquestes habilitats atenent a les distintes dimensions que la conformen: atenció conjunta, conducta de demanda i interacció social. Amb la finalitat de simplificar el model i facilitar així la seua comprensió, s'hi ha omès que les etiquetes d'atenció conjunta, conducta de demanda i interacció social estan compostes a la vegada per una sèrie de conductes específiques, definides en els apartats del Capítol 2 de la "Part I: Revisió Teòrica" del present treball. De la mateixa manera, aquestes conductes específiques constitueixen les variables d'habilitats de comunicació social primerenca que s'exposen a l'apartat 6. 5. 1.

Les fletxes representen les relacions que planteja el model entre els distints elements que el conformen. Aquestes relacions s'estableixen de manera que l'element des d'on parteix la fletxa afecta a l'element on acaba la fletxa. És a dir, les fletxes, les quals connecten elements en distints moments temporals, estan vinculades a anàlisis majoritàriament de tipus predictiu.

En síntesi, aquest és el model conceptual que vertebra el present treball i que inclou tant elements de relació com de predicció per a les habilitats de comunicació social i els signes primerencs de TEA i les habilitats del llenguatge en edats primerenques.

6. 4. Participants

6. 4. 1. Mostra

La mostra està formada per 55 bebès nascuts a la província de València i les seues famílies —24 xiquets (43.6%) i 31 xiquetes (56.4%)—. La mitjana d'edat dels xiquets en la visita dels 8 mesos era de 8.22 mesos, (rang = 8-10; *DT* = 0.55). La mitjana d'edat dels xiquets en la visita dels 12 mesos era de 12.07 mesos, (rang = 12-13; *DT* = 0.25). La mitjana d'edat dels xiquets en la visita dels 18 mesos era de 18.23 mesos, (rang = 18-20; *DT* = 0.57). El reclutament de la mostra es realitzà amb la col·laboració de diversos professionals vinculats a Centres de Salut i Hospitals de la ciutat de València, que informaven sobre el projecte a aquelles famílies que acomplien una sèrie de criteris (taula 1) i oferien la possibilitat de participar-hi facilitant les seues dades per a ser posteriorment contactats pel nostre equip. Aquestos criteris s'organitzen en criteris d'inclusió i criteris d'exclusió, i s'especifiquen en cas de tractar-se de bebès nascuts a terme o de bebès prematurs. Els centres col·laboradors foren els següents: Hospital Universitari i Politècnic La Fe de València, Hospital Casa de Salud de València i Centre de Salut Miguel Servet de València. 7 (11.9%) dels xiquets de la mostra foren reclutats a l'Hospital Universitari i Politècnic de La Fe, 8 (13.6%) dels xiquets provingueren de l'Hospital Casa de Salud de València, 31 (52.5%) xiquets foren reclutats al Centre de Salut Miguel Servet de València i 9 (15.3%) dels xiquets s'incorporaren a l'estudi per altres vies.

Table 1. Inclusion and exclusion criteria for the selection of the sample

BEBÈS PREMATURS	BEBÈS A TERME
Criteris d'inclusió	**Criteris d'inclusió**
1) Tindre 8 mesos o menys (edat corregida). 2) Setmanes de gestació (<37 setmanes): 3) Consentiment patern per a la realització de l'avaluació i l'ús de dades. 4) Capacitat de comprensió del castellà o valencià per part del progenitor.	1) Tindre 8 mesos o menys. 2) Setmanes de gestació (>36 setmanes) i pes adequat en nàixer. 3) Consentiment patern per a la realització de l'avaluació i l'ús de dades. 4) Capacitat de comprensió del castellà o valencià per part del progenitor.
BEBÈS PREMATURS	**BEBÈS A TERME**
Criteris d'exclusió	**Criteris d'exclusió**
1) Presentar alguna condició mèdica associada amb un major risc de trastorn del neurodesenvolupament. 2) Presentar alguna condició mèdica associada a la prematuritat que puga suposar un risc per una discapacitat severa o un trastorn cognitiu, motor o sensorial sever. 3) Presència de trastorn metabòlic, genètic o del neurodesenvolupament.	1) Presentar alguna condició mèdica associada amb un major risc de trastorn del neurodesenvolupament. 2) Presència de complicacions pre peri i/o post natals. 3) Presència de trastorn metabòlic, genètic o del neurodesenvolupament.

Aquesta tesi s'emmarca dintre d'un projecte d'investigació més gran. Aquest projecte es va presentar per a col·laborar amb l'Hospital Universitari i Politècnic de la Fe de València en l'obtenció de la mostra. Per a fer efectiva aquesta col·laboració, el projecte va haver de ser considerat pel Comitè d'Ètica de la Investigació amb Medicaments del mateix hospital, que va resoldre favorablement la col·laboració al·legant que el projecte complia amb els requisits, pel que fa al disseny i pel que fa al tracte amb les famílies participants. Es pot consultar el document d'aprovació a l'annex I.

Dels xiquets participants de la mostra, 38 (69.1%) foren bebès nascuts a terme (>36 setmanes de gestació) i 17 (30.9%) dels bebès foren nascuts prematurs (<37 setmanes de gestació). 47 (85.5%) dels bebès foren nascuts per part únic i 8 (14.5%) foren nascuts per parts de bessons, açò és, participaren a l'estudi 4 parelles de bessons. D'aquests bessons, 7 (87.5%) eren xiquetes i 1 (12.5%) era un xiquet. El 98.18% (54 subjectes) dels parts se succeïren sense complicacions peri- ni post-natals. Solament en un cas la mare va informar d'hipotonia del bebè en nàixer, necessitat de reanimació amb oxigen i una puntuació de 6 al test d'Apgar.

Com hem dit, 38 (69.1%) dels xiquets participants foren bebès nascuts a terme (AT) (>36 setmanes de gestació) i 17 (30.9%) dels bebès foren nascuts prematurs (<37 setmanes de gestació). Dels bebès nascuts a terme, 6 (10.9%) foren bebès a terme límit (ATL) (nascuts en la setmana 37), 32 (58.2%) foren bebès nascuts entre la setmana 37 i la setmana 42 (AT), i cap dels bebès fou post-terme (>42 setmanes de gestació; post-T). Dels bebès prematurs, 5 (9.1%) nasqueren amb menys de 28 setmanes de gestació (prematurs extrems; PE), 3 (5.5%) nasqueren entre la setmana 28 i la setmana 32 de gestació (molt prematurs; MP) i 9 (16.4%) foren bebès nascuts entre la setmana 32 i la setmana 36 (prematurs tardans o moderats; PTM). 4 (7.3%) dels bebès nasqueren amb un pes d'entre 500 i 1000g, 13 (23.6%) dels bebès nasqueren amb un pes d'entre 1001 i 2500g i 38 (69.1%) dels bebès nasqueren amb un pes de més de 2500g. 3 (5.5%) dels bebès

foren petits per a l'edat gestacional (PEG), 42 (76.4%) dels bebès foren adequats per a l'edat gestacional (AEG) i 10 (18.2%) dels bebès foren grans per a l'edat gestacional (GEG). 26 (47.3%) dels xiquets de la mostra eren fills únics en el moment d'incorporació al projecte, 26 (47.3%) tenien un germà o una germana major i 3 (5.5%) tenien més d'un germà o germana major. 2 (3.64%) xiquets participants tenen un familiar de primer ordre —germà o progenitor— amb un trastorn del neurodesenvolupament o amb un diagnòstic clínic (TEA, TDAH i trastorn de la personalitat). 5 (9.1%) dels xiquets participants tenen un familiar de segon ordre —cosí o oncle— amb un trastorn del neurodesenvolupament (TEA i TDAH). En la primera avaluació, als 8 mesos, només 12 (21.8%) dels xiquets participants acudia a una escola infantil al menys dues hores al dia. Aquesta xifra s'incrementa als 12 mesos fins arribar a 18 (32.7%) xiquets i augmenta una miqueta més amb 19 (34.5%) xiquets que als 18 mesos anava a una escola infantil. Totes aquestes característiques que descriuen la mostra es troben resumides a la taula 2.

Table 2. Demographic characteristics of the participating infants

	N = 55	
	N	%
Sexe		
Xiquets	24	43.6
Xiquetes	31	56.4
Centre de Procedència		
Hospital Universitari i Politècnic de La Fe	7	12.7
Hospital Casa de Salud de València	8	14.5
Centre de Salut Miguel Servet de València	31	56.4
Altres vies	9	16.4
Edat Gestacional (*M*sg = 36.71; *DT* = 4.656)		
PE (< 28 sg)	5	9.1
MP (28-32 sg)	3	5.5
PTM (32-36 sg)	9	16.4
AT (≥ 37 sg)	38	69
Pes Gestacional (*M*pg = 2749.76; *DT* = 883.287)		
500-1000g	4	7.3
1001-2500g	12	21,8
+2500g	39	70.9
Adequació del Pes Gestacional		
PEG	3	5.5
AEG	42	76.4
GEG	10	18.2
Tipus de Part		
Part únic	47	85.45
Part de bessons	8	14.55
Nombre de Germans (*M*ng = 0.60; *DT* = 0.655) (rang = 0-3)		
Sense germans.	26	47.3
1 germà o germana major.	26	47.3
2 o més germans i/o germanes majors.	3	5.5
Risc familiar (familiar amb trastorn)		
Familiar de Primer Ordre (germà o progenitor)	2	3.64
Familiar de Segon Ordre (cosí o oncle)	5	9.1

	8M		12M		18M	
	N	%	N	%	N	%
Assisteixen a escola infantil/guarderia	12	21.8	18	32.7	19	34.5

*M*sg=mitjana setmanes de gestació; *M*pg=mitjana pes gestacional; *M*ng=mitjana nombre de germans; *DT*=desviació típica; sg=setmanes de gestació; PE=prematurs extrems; MP=molt prematurs; PTM=prematurs tardans o moderats; PEG=petit per a l'edat gestacional; AEG=adequat per a l'edat gestacional; GEG=gran per a l'edat gestacional; 8M=8 mesos; 12M=12 mesos; 18M=18mesos.

Del total de 55 famílies participants a l'estudi, 1 (1.8%) és una família monoparental mentre que la resta de les 54 (98.2%) són famílies nuclears. 50 (90.9%) d'aquestes famílies són famílies nuclears clàssiques, 1 és una família de tipus extensa, és a dir, amb un o més familiars (cosins o avis) convisquent a la mateixa casa, i 3 (5.5%) són famílies reconstruïdes. El 100% de les famílies són famílies heteroparentals, amb 42 (76.4%) progenitors casats, 11 (20%) vivint en parella, 1 (1.8%) progenitor divorciat i 1 (1.8%) progenitor sense parella. 37 (67.3%) de les famílies participants viuen en entorn urbà, 5 (9.1%) en un entorn rural i 13 (23.6%) en zona residencial. Els ingressos anuals familiars oscil·len entre els 6000€ i els 11999 € en 4 (7.3%) dels casos, entre els 12000€ i els 23999 € en 16 (29.1%) dels casos, entre els 24000 i els 35999 € en 19 (34.5%) dels casos, entre els 36000 i els 50000 € en 12 (21.8%) dels casos, i supera els 50000 € en 4 (7.3%) dels casos. La mitjana d'edat de les mares dels xiquets participants en la primera visita, és a dir, en el moment en què entraren a formar part de l'estudi era de 34.82 amb una desviació típica de 4.761. La mitjana d'edat dels pares dels xiquets participants en la primera visita era de 36.91 amb una desviació típica de 5.074. De les mares participants, 5 (9.1%) tenien una formació bàsica o d'estudis primaris en el moment de començar la investigació, 15 (27.3%) realitzaren estudis mitjans (Batxillerat, i Cicles Mitjans i Superiors) i 35 (63.6%) havien anat a la universitat. Quant als pares, 1 (1.9%) pare de les famílies participants no tenia estudis quan s'enregistrà aquesta dada en la primera visita, 5 (9.4%) d'ells tenien una

formació bàsica o estudis primaris, 20 (37.7%) realitzaren estudis mitjans (Batxillerat, i Cicles Mitjans i Superiors) i 27 (49.1%) havien anat a la universitat (taula 3).

Table 3. Demographic characteristics of the participating families

	Mares (N = 55)		Pares (N = 53)	
	N	%	N	%
Edat (anys)				
20-29	7	12.7	2	3.8
30-40	40	72.7	40	75.5
+ 40	11	20	11	20.8
Estat Civil				
Solter/a	1	1.8	1	1.9
Casat/ada	42	76.4	42	79.2
Viu en parella	11	20	10	18.9
Divorciat/ada	1	1.8	0	0
Educació				
Sense estudis	0	0	1	1.9
Estudis primaris/bàsics	5	9.1	5	9.4
Estudis secundaris	15	27.3	20	37.7
Estudis superiors	35	63.6	27	50.9

	Famílies (N = 55)	
	N	%
Tipus de Família		
Monoparental	1	1.8
Nuclear	50	90.9
Reconstruïda	3	5.5
Extensa	1	1.8
Entorn		
Urbà	37	67.3
Rural	5	9.1
Zona Residencial	13	23.6
Ingressos		
< 6000 €	0	0
6000-11999 €	4	7.3
12000-23999 €	16	29.1
24000-35999 €	19	34.5
36000-49999 €	12	21.8
+ 50000 €	4	7.3

Me=mitjana d'edat; DT=desviació típica.

6. 4. 2. Reclutament de la mostra

Les famílies eren informades inicialment pel seu pediatra o neonatòleg al seu Hospital o Centre de Salut de referència. Les famílies interessades en participar al projecte acceptaven donar les seues dades als professionals de salut, qui traslladaven aquestes dades al personal del projecte. Les famílies eren telefonades a mesura que les seues dades arribaven als nostres arxius per a fer una presentació del personal i resoldre qualsevol dubte en relació a la participació a l'estudi. En aquesta primera presa de contacte, les famílies eren informades sobre la naturalesa longitudinal de l'estudi i l'enfocament observacional del mateix. En aquesta primera telefonada es recollien també les següents dades sobre els menors i les seues famílies, amb l'objectiu de crear un registre propi per a cada participant: nom del xiquet o la xiqueta, nom del pare o la mare, telèfon del pare o la mare, setmanes de gestació, pes en nàixer, sexe del bebè, data de naixement, data de naixement prevista (en cas de ser prematur) i centre de reclutament. Així mateix, s'incorporava en aquest mateix registre les dates en què s'haurien de realitzar cadascuna de les tres avaluacions, la dels 8 mesos la dels 12 mesos i la dels 18 mesos (edat corregida per als prematurs). S'informava a les famílies d'aquestes dates i se'ls recordava que uns dies abans de les mateixes el personal del projecte es posaria en contacte amb ells per establir la data de l'avaluació en el dia i l'hora que millor s'ajustara a la seua disponibilitat.

En el dia de la primera avaluació, les famílies són informades de que participen a l'estudi de manera voluntària i que poden abandonar-lo en qualsevol moment i sense haver de donar cap explicació. Se'ls comunica que totes les dades que es recullen durant el transcurs del projecte estan emparades baix la Llei de Protecció de Dades de Caràcter Personal (LO 15/1999) i que la sessió d'avaluació ha de ser enregistrada en vídeo per al posterior anàlisi. L'acceptació d'aquestes condicions es troba recollida al *Consentiment Informat* (annex II), del qual en tenim dues versions (valencià i castellà) i oferim depenent de l'idioma de preferència dels participants. Totes les famílies signen el Consentiment Informat en la primera sessió. Aquest document incorpora dos nivells de consentiment de manera que les famílies poden escollir adherir-se a un tipus de consentiment o als dos. Aquests dos consentiments són, d'una banda, el consentiment per al visualitzat dels vídeos per part de l'equip del projecte per a l'obtenció dels resultats i, d'altra banda, el consentiment per a l'ús dels vídeos amb finalitat de formació (ús de vídeos per a seminaris, classes i altres modalitats de formació). Per a participar a l'estudi és imprescindible la conformitat amb el primer dels consentiments. El segon dels consentiments és opcional per a les famílies.

6. 4. 3. Manteniment de la mostra

La periodicitat de contacte amb les famílies tendeix a ser alta amb la majoria d'elles. Habitualment, un temps després de cada sessió

d'avaluació se'ls envia una taula amb els resultats de les proves de comunicació prelingüística —*Early Social Communication Scales* (Mundy et al., 2003)— i de desenvolupament del llenguatge —*Inventari de Desenvolupament Comunicatiu MacArthur* (Jackson-Maldonado et al., 2003)—. D'aquesta manera es pretén incrementar la fidelitat de les famílies amb la continuïtat del projecte. També, unes setmanes abans de la cita per a l'avaluació de cada moment evolutiu les famílies són contactades per telèfon. En aquesta telefonada se'ls preguntar per l'evolució dels menuts i s'acorda una data per a la següent sessió. Aquesta proximitat amb les famílies i el fet que la comunicació no se sol interrompre per més de 2 mesos seguits ha permès que la taxa de mortaldat de la mostra no haja superat el 15.54%, amb només 10 famílies que abandonaren el projecte abans de l'avaluació del 12 mesos (mortaldat del 18.18%) i 10 famílies que ho han fet abans de l'avaluació dels 18 mesos fins a l'actualitat—encara no es pot determinar la xifra exacta de mortaldat als 18 mesos perquè aquest és un estudi longitudinal que continua realitzant avaluacions i hi ha famílies que encara no han acudit a la sessió dels 18 mesos—. D'altra banda, tenim 3 famílies que s'han incorporat al projecte quan els seus fills tenien 12 mesos, per tant aquestes famílies constarien com a mortaldat de la mostra als 8 mesos (mortaldat del 5.45%). Per tant, la mostra total de xiquets participants en l'estudi ha estat de 52 als 8 mesos, de 45 als 12 mesos i de 30 als 18 mesos. La majoria d'aquests participants en cada moment d'avaluació són el mateix xiquet que ha estat avaluat als 8, els

12 i els 18 mesos. En alguns casos, són xiquets que han estat avaluats als 8 i als 12 mesos, mentre que en altres casos ho han estat als 8 i als 18 mesos. Una minoria de xiquets participants han estat avaluats només als 8 mesos. Aquestos han estat comptabilitzats com a mortaldat de la mostra. Tot i que s'han considerat per a les anàlisis dels 8 mesos.

6. 5. Instruments i Variables

Abans de passar a exposar i descriure els instruments i les variables de l'estudi, s'inclou una taula (taula 4) a mode de resum que servirà d'índex del present apartat.

Table 4. Summary table of the instruments and variables of the study

INSTRUMENTS	VARIABLES
Early Social-Communication Scales (ESCS) (Mundy et al., 2003)	**Atenció conjunta/*Joint attention***
	Inici d'atenció conjunta (initiating joint attention; IJA)
	IJA de baix nivell (lower level; IJAL)
	IJA d'alt nivell (higher level; IJAH)
	Resposta d'atenció conjunta (responding to joint attention; RJA)
	RJA proximal (RJAP)
	RJA distal (RJAD)
	Conducta de demanda/*Behavioral request*
	Inici de conducta de demanda (initiating behavioral request; IBR)
	IBR de baix nivell (lower level; IBRL)
	IBR d'alt nivell (higher level; IBRH)
	Resposta a la conducta demanda total (responding to behavioral request total) (RBRT)
	Interacció social/*Social interction*
	Inici d'interacció social (initating social interaction; ISI)
	Resposta d'interacció social (responding to social interaction; RSI)
	RSI total (RSIT)
First Year Inventory (FYI) (Baranek et al., 2003)	**Marcadors primerencs de TEA** (RISK12)
Cuestionario de Autismo en la Infancia-Modificado (M-CHAT) (Robins et al., 2001)	**Marcadors primerencs de TEA** (RISK18)
Inventarios de Desarrollo Comunicativo MacArthur (MCDI) (Jackson-Maldonado et al., 2003). Adaptació espanyola de López Ornat et al. (2005).	**Habilitats del Llenguatge als 12 mesos.**
	Vocalitzacions (vocalizations; VOC12)
	Comprensió de paraules (word comprehension; WC12)
	Producció de paraules (word production; WP12)
	Gestos i accions (gestures and actions; GA12)
	Habilitats del Llenguatge als 18 mesos.
	Vocalitzacions (vocalizations; VOC18)
	Producció de paraules (word production; WP18)
	Acabament de paraules (word ending; WEND18)
	Complexitat morfosintàctica (morphosyntactic complexity; MSYC18)

En alguns casos les mesures es repeteixen en els distints moments d'avaluació. És per això que en ocasions el nom de les variables tenen al final un número (8, 12 o 18), que indica el moment d'avaluació.

6. 5. 1. The Early Social-Communication Scales (ESCS)

L'ESCS (Mundy et al., 2003) és un instrument d'observació semiestructurada gravada en vídeo i codificada posteriorment, dissenyat per a l'avaluació de conductes comunicatives en xiquets preverbals. Té una durada de 15 a 25 minuts i pot ser usada tant amb xiquets amb desenvolupament típic com amb xiquets amb dificultats en el desenvolupament que estiguen entre els 8 i els 30 mesos d'edat. La realització de la prova es fa a través d'una sèrie de situacions de joc semiestructurades que pretenen afavorir la interacció entre un examinador adult i el xiquet participant.

La realització d'aquestes situacions de joc ve marcada per un protocol d'ús d'una sèrie de joguets i de jocs que es troben enumerats al manual de lliure accés i que han de ser administrats seguint una sèrie de directrius. El mateix manual indica l'ordre d'administració i ús de cada joguet, així com els temps que cal esperar o no per a cada canvi d'activitat o per a cada activitat. Amb tot, el protocol permet flexibilitat amb la finalitat d'adaptar-se a la situació, als gustos i a les característiques del xiquet si és necessari.

Els examinadors que realitzaren l'administració de la prova als xiquets de la mostra en els distints moments d'avaluació participaren en una sèrie de sessions formatives on examinadors amb experiència prèvia entrenaven a nous examinadors per a la utilització de l'instrument. Així mateix, abans d'emprar l'instrument en les sessions d'avaluació amb els xiquets, s'hi realitzaven una sèrie de sessions de

pràctica amb els mateixos companys examinadors i amb xiquets pilot. En aquestes mateixes sessions formatives, es realitzava també l'entrenament per a la codificació posterior dels vídeos. Les instruccions per a l'aplicació de les escales ESCS es troben en els paràgrafs posteriors i les instruccions per a la identificació i la codificació de les distintes conductes es troben a l'annex IV. *Taula de Codificació*.

L'administració de la prova s'ha de fer a una **sala** on solament hi haja una taula, dues cadires, 4 pòsters penjants a la paret, la caixa amb els joguets i una càmera que enregistre la sessió. La prova es realitza emprant la taula, amb l'examinador assegut a la cadira a un costat de la taula (donant l'esquena a la càmera) i el xiquet assegut sobre els braços de un dels seus progenitors a la cadira a l'altre costat de la taula, mirant de cara a l'examinador (quedant-se la càmera enfront). Penjats en les parets de l'esquerra i la dreta del xiquet, i a la paret de darrere del xiquet, un a cada costat (dret i esquerre), han d'haver uns pòsters amb imatges d'interès infantil.

Els **joguets** que s'empren per a l'avaluació amb aquest instrument són:

- Una pilota (20 cm de diàmetre).
- 3 joguets de corda.
- 2 joguets de tipus manuals (per exemple, 2 titelles).
- 2 globus del mateix color.

- Un llibre amb imatges grans que resulten atractives per a xiquets de pocs mesos.
- 4 pòsters/imatges de paret.
- Una pinta.
- Un barret.
- Unes ulleres de joguet.
- Un cotxet de joguet.
- Un recipient de plàstic amb una tapa roscada.

Les **tasques** que es realitzen per a l'avaluació amb aquest instrument són:

– *Tasca objecte espectacle*: durant aquestos episodis, l'examinador posa en marxa un dels joguets de corda i espera la reacció del xiquet. Aquesta tasca es realitza fins a tres vegades en un mateix episodi i cada episodi es repeteix fins a tres vegades en el transcurs de la prova. Així mateix, dintre d'aquest tipus de tasca s'hi inclouen el joc amb el globus que inflem i oferim al menut, i els episodis de joguet manual, és a dir, el joc amb les titelles. Després de cada vegada que s'ha posat en marxa cada joguet de corda, l'examinador ha de fer una petició d'ordre clara i emprant l'imperatiu: "Dona-me'l" (primer amb una ordre només verbal i després, si el xiquet no respon, amb l'ordre verbal acompanyada del gest de la ma amb la palma cap per amunt).

– *Invitació al joc*: es tracta d'un episodi on l'examinador convida a jugar amb la pinta, el barret o les ulleres. Ha de ser un joc social i ha de ser el xiquet qui mostre iniciativa per participar, ja siga pentinant a l'examinador, posant-li el barret o posant-li les ulleres.

– *Joc de torns*: l'examinador situa el joguet (la pilota o el cotxet) damunt de la taula i espera primer la reacció del xiquet. Si aquest no inicia el joc de torns, és l'examinador qui comença el joc i espera que el xiquet responga adequadament tornant la pilota o el cotxet.

– *Atenció conjunta proximal/distal*: en aquestos episodis l'examinador assenyala una imatge proximal (llibre) o una imatge distal (pòsters penjants a la paret) i espera la resposta del xiquet.

– *Pessigolles*: l'examinador canta una cançoneta mentre s'arrima poc a poc al xiquet per a fer-li pessigolles. S'hi repeteix el mateix tres vegades deixant 5 segons de temps per cada vegada que es fa pessigolles.

– *Episodi amb el pot de plàstic amb tapa roscada*: en aquest episodi l'examinador introdueix dos dels joguets de corda dintre del pot i enrosca la tapa. Després ofereix el pot al xiquet i espera la seua reacció. Si el xiquet dona el pot a l'examinador com buscant que aquest l'òbriga per traure el joguet, l'examinador l'obri per traure l'objecte i l'episodi s'acaba. Si el xiquet no dona el pot a l'examinador, aquest ha de realitzar la tasca de petició d'ordre: "Dona-me'l".

Un suggeriment d'**ordre de presentació** de les distintes tasques i episodis seria el següent:

1. Joc de torns: pilota.
2. Objecte espectacle: joguet de corda 1.
3. Objecte espectacle: globus.
4. Pessigolles 1.
5. Pòsters: atenció conjunta distal.
6. Objecte espectacle: joguet de corda 2.
7. Objecte espectacle: titella 1.
8. Llibre: atenció conjunta proximal.
9. Invitació al joc: barret.
10. Invitació al joc: ulleres.
11. Objecte espectacle: titella 2.
12. Joc de torns: cotxe.
13. Pot de plàstic amb tapa roscada 1.
14. Objecte espectacle: joguet de corda 3.
15. Pot de plàstic amb tapa roscada 2.
16. Pessigolles 2.
17. Pòsters: atenció conjunta distal.

Com ja s'ha dit, tot el procediment és registrat en vídeo per a ser posteriorment visualitzat i codificat. **Les conductes s'enregistren en mode i en freqüència**, és a dir, s'hi anota quines conductes de comunicació social primerenca es donen durant la interacció i quantes

vegades hi apareix cada conducta. Aquesta informació s'enregistra a un *Registre de Codificació* que proporciona el mateix instrument (annex V).

Quant al mode que prenen les distintes conductes comunicatives que avalua l'instrument, aquestes es poden classificar atenent a característiques com:

(a) Objectiu comunicatiu: comunicació protodeclarativa, comunicació protoimperativa o aconseguir interacció social.

(b) Si és el xiquet qui inicia la interacció o qui respon a l'oferta de l'examinador

(c) Estadi del desenvolupament (simple / complex).

Així, podem parlar de les següents conductes:

CONDUCTES D'ATENCIÓ CONJUNTA (*joint attention*).

- Inici d'atenció conjunta (*initiating joint attention*, IJA)

  Baix nivell (*lower level;* IJAL).

  Alt nivell (*higher level;* IJAH).

  Inici d'atenció conjunta, puntuació total (IJAT) (IJAL+IJAH)

- Resposta d'atenció conjunta (*responding to joint attention*, RJA)

  Proximal (RJAP).

  Distal (RJAD).

CONDUCTES DE DEMANDA (*behavioral request*).

- Inici de conducta de demanda (*initating behavioral request*, IBR)

  Baix nivell (*lower level;* IBRL).

  Alt nivell (*higher level*; IBRH).

  Inici de conducta de demanda, puntuació total (IBRT) (IBL+IBRH)

- Resposta a la petició de demanda (*responding to behavioral request*, RBR)

  Amb gest que acompanya l'ordre verbal (RBRW).

  Sense gest que acompanya l'ordre verbal (RBRWO).

  Resposta a la petició de demanda, puntuació total (RBRT) (RBRW+RBRWO)

INTERACCIÓ SOCIAL (*social interaction*)

- Inici d'interacció social (*initating social interaction*, ISI)
- Resposta a la interacció social (*responding to social interaction*, RSI)

  Baix nivell (*lower level;* RSIL).

  Alt nivell (*higher level;* RSIH).

  Resposta a la interacció social, puntuació total (RSIT) (RSIL+RSIH)

Aquestes conductes es definiran i s'explicaran amb més detall uns paràgrafs més endavant.

Quant a la freqüència, aquestes conductes objecte s'enregistren a un document de *Registre de Codificació* (annex V) de manera que s'hi anota una ocurrència per cada vegada que s'observa cada conducta i s'extrau el nombre total de vegades que es dona cada conducta en els seus diferents subtipus. A la *Taula de Codificació* de l'annex IV s'especifica quan una conducta de comunicació ha de considerar-se dintre d'una etiqueta o d'una altra, atenent a qüestions com ara "el joguet està en marxa o està parat", "el xiquet realitza la conducta espontàniament i no com a imitació de l'examinador", etc.

L'ESCS s'ha emprat per a mesurar les *habilitats de comunicació social preverbal,* element central del present treball d'investigació. S'inclouen tres grans grups de conductes, que es subdivideixen a la vegada en successives dimensions o subtipus. Aquests tres grups de conductes són: (1) Conductes d'Atenció Conjunta, (2) Conductes de Demanda, i (3) Conductes d'Interacció Social. A continuació, s'explica amb detall cadascuna de les dimensions de l'instrument i quines d'aquestes dimensions s'han escollit per a constituir les variables referents a les habilitats de comunicació social primerenca.

a) Conductes d'atenció conjunta (*joint attention*): ús de conducta no verbal per compartir amb l'examinador interès cap a una joguina o un joc.

i. Inici d'atenció conjunta (*initiating joint attention*, IJA): quan és el xiquet qui inicia la conducta d'atenció conjunta.

- Baix nivell (IJAL): alternança de mirada entre el joguet i l'adult.
- Baix nivell (IJAH): ús de gestos com assenyalar, donar o mostrar.

Inici d'atenció conjunta, puntuació total (IJAT) (IJAL+IJAH)

ii. Resposta a l'atenció conjunta (*responding to joint attention*, RJA): el xiquet respon a una invitació d'atenció conjunta que realitza l'examinador, per exemple, girant el cap cap a l'objecte.

- Resposta d'atenció conjunta proximal (RJAP): el xiquet respon girant el cap per mirar alguna cosa que està prop —la imatge d'un llibre que l'adult acaba d'assenyalar—.
- Resposta d'atenció conjunta distal (RJAD): el xiquet respon girant el cap per mirar alguna cosa que està lluny —un pòster penjat a la paret que l'adult acaba d'assenyalar—.

b) Conductes de demanda (*behavioral request*): ús de conductes no verbals de petició d'ajuda a l'adult per arribar a un objecte o aconseguir alguna finalitat.

iii. Inici de conducta de demanda (*initating behavioral request*, IBR): el xiquet realitza la demanda a l'examinador, per exemple, demanar que pose en marxa un joguet.

- Baix nivell (IBRL): alternança de mirada entre el joguet i l'adult.
- Baix nivell (IBRH): ús de gestos com assenyalar, donar o mostrar.

Inici de conducta de demanda, puntuació total (IBRT) (IBL+IBRH)

iv. Resposta a la petició de demanda (*responding to behavioral request*, RBR): el xiquet respon a una demanda o una ordre que ha realitzat l'examinador, per exemple, donar una joguina quan se li diu "Dona'm".

- Amb gest (RBRW): el xiquet respon a l'ordre verbal si aquesta va acompanyada del el gest de la mà.

- Sense gest (RBRWO): el xiquet respon a l'ordre verbal sense necessitat d'acompanyament amb el gest de la mà.

Resposta a la petició de demanda, puntuació total (RBRT) (RBRW+RBRWO)

c) Interacció social (*social interaction*): capacitat de participar en interaccions lúdiques, d'afecte positiu en alternança de torns amb l'examinador.

v. Inici d'interacció social (*initating social interaction*, ISI): el xiquet té la iniciativa d'iniciar una situació d'interacció social, per exemple, llançant la pilota cap al examinador perquè aquest es la retorne.

vi. Resposta a la interacció social (*responding to social interaction*, RSI): el xiquet accedeix a participar en una situació d'interacció social promoguda per l'examinador, per exemple, rient quan l'examinador li fa pessigolles o participant en un joc de posar-se un barret, unes ulleres de sol o pentinar-se.

- Baix nivell (RSIL): participació al joc de torns, retornant la pilota o el cotxet de joguet a l'examinador quan aquest li'l llança al xiquet.

- Alt nivell (RSIH): participació al joc de posar-se un barret o unes ulleres de sol, o pentinar-se. El xiquet li posa el barret o es ulleres de sol a l'examinador, o li pentina els cabells, front a la invitació de "Juguem?" després de posar aquestos objectes sobre la taula.

Resposta a la interacció social, puntuació total (RSIT) (RSIL+RSIH)

Les dimensions que s'han escollit per a constituir les variables referents a les *habilitats de comunicació social primerenca* són les següents: IJAL, IJAH, RJAP, RJAD, IBRL, IBRH, RBRT, ISI, RSIT. La decisió d'emprar aquestes categories de l'ESCS se sustenta sobre les investigacions anteriors, que expliquen que les mesures que resulten informatives a l'hora de predir aspectes del desenvolupament com ara el llenguatge o predir qüestions com ara el risc de trastorns al neurodesenvolupament són precisament aquestes (Franchini et al., 2019; Mundy et al., 2007; Pickard & Ingersoll, 2015; Salo et al., 2018; Schertz & Odom, 2007; Schertz et al., 2018).

Per assegurar la qualitat de les dades, i tractant-se d'un instrument de puntuacions quantitatives però d'obtenció per observació, s'han realitzat codificacions per dos observadors de manera independent amb el 54.33% del total registre. Així mateix, s'ha calculat l'acord inter-jutges per a cada dimensió de l'instrument. La mitjana de la fiabilitat

del registre (*correlació intraclasse*) ha estat de .768 per a les mesures dels 8 mesos, de .814 per a les mesures dels 12 mesos i de .814 per a les mesures dels 18 mesos. A continuació, s'inclouen distintes taules on apareix més detallada la informació referent a aquesta fiabilitat inter-jutges (2 observadors) en l'instrument d'observació ESCS per a cada moment evolutiu. Cal apuntar que no s'ha realitzat el càlcul de la fiabilitat en el cas de les variables IBRH i RBRT als 8 mesos, perquè fan referència a dues conductes que encara no s'hi observen en edats tan primerenques.

Table 5. Inter-judges reliability for each early social communication variable at 8 months

	Coeficient de correlació intraclasse[a]							
			95% interval de confiança					
	Alfa de Cronbach	Correlació intraclasse[b]	Límit inferior	Límit superior	Sig	N	TOTAL	%*
IJAL8	.953	.952[c]	0.906	0.975	<.001	36	52	69.23
IJAH8	.784	.785[c]	0.580	0.890	<.001	36	52	69.23
RJAP8	.829	.822[c]	0.653	0.909	<.001	36	52	69.23
RJAD8	.756	.746[c]	0.507	0.870	<.001	36	52	69.23
IBRL8	.850	.839[c]	0.681	0.918	<.001	36	52	69.23
ISI8	.824	.824[c]	0.657	0.910	<.001	36	52	69.23
RSIT8	.402	.406[c]	-0.175	0.699	.067	36	52	69.23

Model de dos factors d'efectes mixtos on els efectes de persones són aleatoris i els efectes de mesures són fixos

a. L'estimador és el mateix. estiga present o no l'efecte d'interacció

b. Coeficients de correlació intraclasse de tipus A que utilitzen una definició d'acord absolut

c. Aquesta estimació es calcula suposant que l'efecte d'interacció està absent. perquè en cas contrari no es pot estimar

**% de casos per al càlcul de la fiabilitat*

Table 6. Inter-judges reliability for each early social communication variable at 12 months

Coeficient de correlació intraclasse[a]								
			95% interval de confiança					
	Alfa de Cronbach	Correlació intraclasse[b]	Límit inferior	Límit superior	Sig	N	TOTAL	%*
IJAL12	.946	.940[c]	0.845	0.976	<.001	21	45	47.72
IJAH12	.836	.828[c]	0.584	0.929	<.001	21	45	47.72
RJAP12	.738	.736[c]	0.362	0.892	<.001	21	45	47.72
RJAD12	.981	.981[c]	0.954	0.992	<.001	21	45	47.72
IBRL12	.636	.644[c]	0.112	0.856	.014	21	45	47.72
IBRH12	.848	.809[c]	0.461	0.927	<.001	21	45	47.72
RBRT12	.928	.928[c]	0.825	0.970	<.001	21	45	47.72
ISI12	.827	.824[c]	0.575	0.928	<.001	21	45	47.72
RSIT12	.633	.635[c]	0.109	0.851	.015	21	45	47.72

Model de dos factors d'efectes mixtos on els efectes de persones són aleatoris i els efectes de mesures són fixos

a. L'estimador és el mateix. estiga present o no l'efecte d'interacció

b. Coeficients de correlació intraclasse de tipus A que utilitzen una definició d'acord absolut

c. Aquesta estimació es calcula suposant que l'efecte d'interacció està absent. perquè en cas contrari no es pot estimar

**% de casos per al càlcul de la fiabilitat*

Table 7. Inter-judges reliability for each early social communication variable at 18 months

Coeficient de correlació intraclasse[a]								
			95% interval de confiança					
	Alfa de Cronbach	Correlació intraclasse[b]	Límit inferior	Límit superior	Sig	N	TOTAL	%*
IJAL18	.886	.890[c]	0.626	0.968	.001	12	30	40
IJAH18	.703	.691[c]	0.012	0.909	.028	12	30	40
RJAP18	.913	.913[c]	0.711	0.975	<.001	12	30	40
RJAD18	.964	.960[c]	0.861	0.988	<.001	12	30	40
IBRL18	.916	.921[c]	0.725	0.977	<.001	12	30	40
IBRH18	.945	.938[c]	0.786	0.982	<.001	12	30	40
RBRT18	.579	.558[c]	-0.355	0.868	.083	12	30	40
ISI18	.899	.898[c]	0.663	0.970	<.001	12	30	40
RSIT18	.583	.555[c]	-0.332	0.866	.081	12	30	40

Model de dos factors d'efectes mixtos on els efectes de persones són aleatoris i els efectes de mesures són fixos

a. L'estimador és el mateix. estiga present o no l'efecte d'interacció.

b. Coeficients de correlació intraclasse de tipus A que utilitzen una definició d'acord absolut.

c. Aquesta estimació es calcula suposant que l'efecte d'interacció està absent. perquè en cas contrari no es pot estimar

**% de casos per al càlcul de la fiabilitat*

Com veiem, l'alpha de Cronbach és elevada per a pràcticament la totalitat dels casos i la significació ($p < .05$) està freqüentment present en els resultats per a cada doble codificació.

Per acabar, mencionar que la utilització d'aquest instrument s'ha realitzat baix autorització personal dels mateixos autors, Mundy i col·laboradors (2003).

6. 5. 2. The First Year Inventory (FYI)

El FYI (Baranek et al., 2003) és un qüestionari per a pares que cobreix dos grans aspectes del desenvolupament infantil: la comunicació social i les funcions reguladores sensorials. Està dissenyat per a la identificació de primers signes de TEA, o de qualsevol altre trastorn del desenvolupament relacionat, en població infantil de 12 mesos. A partir dels dos dominis generals mencionats —comunicació social i funcions reguladores sensorials— s'especifiquen huit dimensions referents als aspectes del desenvolupament on més dificultats solen mostrar els xiquets amb TEA: orientació social i comunicació receptiva, compromís social-afectiu, imitació, comunicació expressiva, processament sensorial, patrons reguladors, reactivitat i comportament repetitiu. Addicionalment, s'inclouen també ítems referents a marcadors de dificultats generals del desenvolupament, com ara les habilitats de pressió en pinça, de suportar pes i les habilitats de pujada i baixada d'escales; i qüestions

mèdiques d'interès general, com ara infeccions d'oïda. Tot i que aquestes qüestions no són especifiques de l'autisme, s'ha vist que un 75% dels xiquets amb TEA presenten aquestes problemàtiques (Reznick, Baranek, Reavis, Watson, & Crais, 2007) i per això poden acabar sent determinants per al diagnòstic diferencial.

Els 63 ítems del FYI es basen en la recerca relacionada amb els símptomes primerencs del TEA, provinents de branques com ara la investigació retrospectiva en infants que tenen diagnòstic de TEA, estudis de validació prospectiva de resultats diagnòstics en bebès amb un any d'edat, comparacions retrospectives de xiquets amb TEA i xiquets amb altres problemes al desenvolupament (Watson et al., 2007), o estudis amb mostres de germans de xiquets amb autisme (Baranek et al., 2015). La redacció de cada ítem fou formulada i refinada a partir del feedback obtingut per part d'un grup d'experts en autisme i en treball conjunt amb les famílies.

El ítems estan dissenyats per a explorar els indicadors de simptomatologia precoç de TEA en base a les següents característiques:

- Satisfacció en passar temps sol.
- Poca o absent resposta d'orientació social quan se li crida pel nom.
- Alteracions en l'ús de conductes de comunicació no verbal que regulen la interacció social, com ara el contacte ocular, l'expressió facial, la postura corporal.

- Baixa inclinació cap a buscar l'interès compartit amb una altra persona (baixa freqüència de gestos com ara d'assenyalar cap als objectes, mostrar-los o oferir-los a l'altre)
- Baixa resposta a la invitació a compartir un focus d'interès comú: baixa resposta en la situació en què l'adult assenyala alguna cosa amb entusiasme i diu, per exemple, "Mira!".
- Poc ús dels gestos comunicatius de consens com ara dir adeu amb la mà
- Baixa reciprocitat social i emocional.
- Recerca de l'adult per a finalitats com ara el confort després d'una situació estressant.
- Mirada a l'adult, conegut o desconegut, quan aquest parla.
- Joc repetitiu o estereotipat.
- Balboteig atípic.
- Vocalitzacions no comunicatives, que no encaixen en el tipus de balboteig compartit que es pot donar en situacions de "protoconversa" on les interaccions de torns entre les vocalitzacions de l'adult i la resposta del xiquet s'assemblen a una conversa real. L'adult diu alguna cosa com ara "T'agrada aquest joc?" i el xiquet fa alguna vocalització i després calla com esperant la nova intervenció de l'adult, com en una conversa on els interlocutors respecten el torn de paraula.
- Ús atípic del llenguatge: ecolàlia.
- Hipersensibilitat o aversió a certes textures o sabors.

- Sobresalt i mostres d'irritabilitat o pors front al so d'un objecte familiar, com ara, una aspiradora.
- Estereotípies: agitació de mans, moviment inusual dels dits, balanceig, assentiment repetitiu amb el cap, caminar de puntetes, llepat inadequat, olfacte atípic.
- Bones habilitats motores en quant a accions com ara córrer, escalar o saltar, però dèficits amb habilitats motores com ara la coordinació o la planificació motora a l'hora de seqüenciar moviments.
- Gran irritabilitat en canviar d'activitat.
- Dificultats per a establir cicles de son-vigília o d'alimentació regulars.

Els ítems estan formulats de manera que els pares han de respondre en base a la freqüència en què es donen les conductes d'interès. 46 dels 63 ítems estan formulats sobre quatre opcions de resposta: *mai*, *poques vegades*, *algunes vegades* i *sovint*. La resta dels 14 ítems tenen 3 o 4 alternatives de resposta ad hoc (alternativa *a*, alternativa *b*, alternativa *c* o alternativa *d*). Finalment, s'inclou un ítem on els pares han de seleccionar els sons que han escoltat que el seu fill o filla sap pronunciar (*p, b, t, d, k, g, m, n, w, y , h, s*), i dues preguntes obertes sobre qüestions mèdiques generals que poden ser d'interès. Per a la correcció del FYI i l'establiment de primera simptomatologia TEA s'examinaren les propietats psicomètriques de l'instrument i es desenvolupà un algoritme de puntuació basat en la distribució de les

puntuacions dels ítems en una mostra normativa de 1496 infants de Carolina del Nord, Estats Units d'Amèrica (Reznick et al., 2007).

És un instrument que s'empra més habitualment en investigació. Tanmateix, en l'actualitat el FYI està en procés de poder ser adaptat per al seu ús en la pràctica clínica. També ha estat traduït a diversos idiomes, incloent l'espanyol, l'hebreu, l'holandès-flamenc, l'italià i el xinès, per a estudis de recerca internacionals.

La utilització d'aquest instrument s'ha realitzat baix autorització personal dels autors del mateix i s'ha emprat per a l'avaluació de la variable *marcadors primerencs de TEA als 12 mesos* (RISK12).

6. 5. 3. Qüestionari d'Autisme en la Infància-Modificat (M-CHAT)

L'M-CHAT (Robins et al., 2009) es un qüestionari parental de 23 ítems amb opcions de resposta Si/No, per a la identificació de conductes primerenques associades al TEA-*screening* per a xiquets entre 16 i 30 mesos d'edat. És un instrument d'ús gratuït per a propòsits clínics, de recerca i formatius.

L'objectiu principal del M-CHAT-R (Robins et al., 2001) és aconseguir la màxima sensibilitat, és a dir, detectar el major nombre de casos de TEA que siga possible. Açò significa que l'instrument té una alta taxa de falsos positius, la qual cosa vol dir que no tots els xiquets que obtinguen una qualificació en risc seran diagnosticats de TEA. No

obstant, el valor predictiu de l'M-CHAT (Robins et al., 2001), és a dir, la proporció de xiquets que identifica l'instrument i que posteriorment reben el diagnòstic, s'estima que és del 92% (Mundy, 2016). En un estudi de Robins i col·laboradors (2014), els xiquets amb una puntuació total ≥3 inicialment i una puntuació de ≥2 després del *follow-up*, tenien un risc del 47.5% de ser diagnosticats de TEA i un risc del 94.6% de rebre el diagnòstic d'algun altre trastorn del desenvolupament.

Algunes de les preguntes que s'inclouen en el M-CHAT (Robins et al., 2001) són: "Utilitza alguna vegada el seu fill el dit índex per assenyalar o per demanar alguna cosa?", "Alguna vegada el seu fill li ha portat objectes per mostrar-li'ls?", "Al seu fill o filla li semblen massa sensible sorolls poc intensos? (Per exemple, reacciona tapant-se les orelles, etc.)", "El seu fill o filla s'interessa per els altres xiquets? (Per exemple, mira amb atenció a altres xiquets, els somriu o s'acosta a ells)", "El seu fill o filla respon quan se li crida pel seu nom? (Per exemple, gira el cap, parla o balbuceja, o deixa de fer el que estava fent per mirar-lo)".

Per a tots els ítems, excepte el 2, 5 i 12, la resposta "NO" indica risc de TEA; per als ítems 2, 5, i 12, la resposta "SÍ" indica risc de TEA. A partir del el nombre d'ítems puntuats amb risc, es pot establir:

- Baix risc: Puntuació total entre 0-2.

- Risc mitjà: Puntuació total entre 3-7. Administrar l'entrevista de seguiment (M-CHAT-R/F). Si la puntuació M-CHAT-R/F es manté en 2 o superior, el resultat final és positiu.

- Risc alt: Puntuació total entre 8-20. És acceptable prescindir de l'entrevista de seguiment i s'ha de remetre el cas immediatament per a avaluació diagnòstica i per a determinar la necessitat d'intervenció primerenca.

Com indica al cas de risc mitjà, l'M-CHAT (Robins et al., 2001) és un instrument de dues fases. La primera fase la formen els 23 ítems en resposta Si/No. En la segona fase, s'indaga amb major profunditat en els ítems que han donat positius, açò és, les respostes "NO", excepte els ítems 2, 5 i 12, on la resposta que dona positiu en risc és "SI". En aquesta segona fase s'administra l'M-CHAT-R/F que conté preguntes més concretes com ara:

➡ "Si vostè assenyala a alguna cosa a l'altra banda de l'habitació, el seu fill o filla mira cap el que vostè assenyala?" "Per favor, done'm un exemple de com respon si vostè assenyala a alguna cosa."

"Mira l'objecte"

"Assenyala a l'objecte"

"Mira i diu alguna cosa sobre l'objecte"

"Mira si el pare assenyala i diu *mira!*"

➡ “El seu fill o filla fa jocs d'imaginació o de fantasia?” “Per favor, done’m un exemple dels jocs imaginatius del seu fill o filla”.

“Fingeix beure d'una tassa de joguet?”

“Fingeix menjar amb una cullera o forqueta de joguina?”

“Fingeix parlar per telèfon?”

“Fingeix donar de menjar a una nina amb menjar de joguet o de veritat?”

“Empeny un cotxe fent com que va per una carretera imaginària?”

“Fingeix ser un robot, un avió, una ballarina, o qualsevol altre personatge favorit?”

“Posa un perol de joguet en una cuina de mentida?”

“Remena menjar imaginari?”

“Posa una figura d'acció o nina en un cotxe o camió de joguet com si fora el conductor o el passatger?”

“Fingeix passar l'aspiradora a la catifa, escombrar, o tallar la gespa?”

“Un altre (descriga)”

➡ “Fa moviments inusuals amb els seus dits prop dels seus ulls?” “Per favor, descriga aquests moviments.”

“Mou els dits prop dels seus ulls.”

"Posa les mans a dalt, prop dels seus ulls?"

"Posa les mans als costats del seu cap?"

"Aleteja les seues mans prop de la seua cara."

"Un altre (descriga)."

➡ "El seu fill o filla assenyala amb el dit per demanar alguna cosa o demanar ajuda?" "Si el seu fill o filla vol alguna cosa que no pot arribar a agafar, per exemple una galeta d'un armari que està alt, com ho aconsegueix?"

"Estén la mà oberta cap a l'objecte."

"El guia a vostè cap a l'objecte."

"Tracta d'assolir l'objecte ell o ella mateix."

"Demana l'objecte amb paraules o sons."

Després de l'administració d'aquesta segona fase, es torna a realitzar el recompte de puntuacions en positiu per al risc, aquesta vegada amb l'etiqueta "PASSA/NO PASSA", i es recupera com a resultat final la classificació de Baix risc (puntuació 0-2), Risc mitjà (puntuació 3-7) i Risc alt (puntuació 8-20).

L'M-CHAT (Robins et al., 2001) s'ha emprat per a l'avaluació de la variable *marcadors primerencs de TEA als 18 mesos* (RISK18).

6. 5. 4. Inventaris de Desenvolupament Comunicatiu MacArthur (MCDI)

L'Inventari de Desenvolupament Comunicatiu MacArthur, amb nom original *MacArthur Communicative Development Inventories* (MCDI) (Jackson-Maldonado et al. 2003), és un instrument d'avaluació que mesura els nivells de llenguatge i de comunicació de xiquets dels 8 als 30 mesos. Es tracta d'un informe de pares a mode de llista de conductes (*checklists*) que té una duració estimada d'entre 60 i 90 minuts.

És un instrument altament utilitzat en la pràctica clínica per al diagnòstic i tractament de les dificultats del llenguatge en les etapes primerenques del desenvolupament, així com en el camp de la investigació com a eina essencial per estudiar els processos d'adquisició del llenguatge i de les habilitats de comunicació. S'ha vingut utilitzant abundantment en diferents contextos amb població americana i han estat adaptats a nombroses llengües.

Conté un nombre extens de conductes comunicatives i un nombre marcadament ampli d'habilitats lingüístiques. Per a cada apartat, s'hi obtenen puntuacions directes i puntuacions percentils. L'estructura de l'instrument està organitzada en dos formes:

- Forma per a xiquets d'entre 8 i 16 mesos, que inclou els apartats de (1) Vocalitzacions, (2) Primeres Paraules, i (3) Gestos.

- Forma per a xiquets d'entre 16 i 30 mesos, que inclou els apartats de (1) Vocalitzacions, (2) Vocabulari, i (3) Oracions.

A continuació, es descriuen amb major detall aquestos formularis.

FORMULARI 8-15 MESOS

El quadernet per a xiquets d'entre 8 i 15 mesos, utilitzat per a l'avaluació de les habilitats del llenguatge en la visita dels 12 mesos, conté els apartats següents:

PART 0: Vocalitzacions. Aquest apartat està format per ítems que pregunten als pares sobre emissions dels seus fills, com ara: vocalitzacions que acompanyen a les primeres manifestacions referencials protoimperatives i protodeclaratives; protoconverses; desenvolupament segmental (balboteig canònic i variat); imitació de paraula i d'entonació; vocalitzacions en contextos no comunicatius; desenvolupament suprasegmental (argot).

PART 1: Primeres Paraules.

I. Comprensió primerenca. Inclou conductes de comprensió comunicativa com ara la resposta quan se li diu el nom, se li dona una orde com és "no", o la conducta de mirar cap a un costat i cap a l'altre quan criden al pare o a la mare.

II. **Comprensió global de frases.** Registre de comprensió general de frases comuns. *Exemples*: "Obri la boca", "A callar", "A dormir", "Amunt", "Molt bé", "Compte", "Dona'm/Dona-li", "Digues adeu", "On està...?", "Això no es fa", "Mira", "Què vols?", "Qui és?", "Vols més?", "Tens pupa?", "Tira això", "Porta... (la pilota)", "Anem", "Ja", "Ja ve papà/mamà", etc.

III. **Producció primerenca.** Registre conductual d'habilitats generals de producció. Per exemple, demanar que se'ls diga el nom de les coses que veuen assenyalant amb el dit i dient "atò?" ("açò?"), o dir les coses o persones que van veient per casa, pel carrer.

IV. **Vocabulari (receptiu i productiu).** Paraules, expressions o interjeccions que el xiquet compren o diu.

- **Interjeccions i sons d'animals i coses.** *Exemples*: "aúpa", "ai!", "beeee", "brumbrum (cotxe)", "piu piu", "miau", "gua-guáu", "pií-pií (cotxe)"

- **Jocs, rutines i fórmules socials:** *Exemples*: "a vore", "a vestir-se", "adeu", "espera", "hola", "no", "no hi ha", "pupa", "caca", "shh (a callar)", "per favor", "sí", "(ú, dos) i tres".

- **Animals, de veritat o de joguet.** *Exemples*: "cavall", "porquet", "conill", "gallina", "gat", "formiga", "lleó", "mosca", "mico", "pardalet", "gos", "peix", "tigre", "vaca", "pollet".

- **Persones.** *Exemples*: “avia/iaia”, “avi/iaio”, “germana”, “germà”, “mamà/mami”, “nena”, “nene”, “nom propi* (nom d’una persona coneguda), “papà/papi”, “tata/teta” “tete”, “tia”.

- **Parts del cos.** *Exemples*: “panxa”, “bigot”, “boca”, “braços”, “cap”, “cul”, “dits”, “dents”, “llengua”, “nas”, “ulls”, “melic”, “orelles”, “cames”, “peus”.

- **Joguets.** *Exemples*: “baló”, “caixa”, “conte/llibre”, “foto (càmera)”, “futbol”, “globus”, “gol”, “joguet”, “llapis”, “nina”, “música”, “osset”, “paper”, “pilota”, “puzle”, “tambor”.

- **Vehicles, de veritat o de mentida.** *Exemples*: “avió”, “autobús”, “barco”, “bici”, “camió”, “cotxe”, “moto”, “tren”.

- **Aliments i begudes.** *Exemples*: “aigua”, “biberó”, “caramel”, “llet”, “carn/txitxa”, “xocolate”, “menjar”, “galeta”, “pa”, “creïlles”, “formatge”, “iogurt”, “suc”.

- **Roba.** *Exemples*: “abric”, “pitet”, “bota/es”, “bufanda”, “botó”, “calcetí/ns”, “camiseta”, “jaqueta”, “barret”, “jersei”, “pantaló/ns”, “bolquer”, “pijama”, “roba”, “sabata/es”.

- **Objectes i llocs de la casa.** *Exemples*: “banyera”, “fem”, “caixó”, “llit”, “pinta”, “raspall”, “xumet”, “cuina”, “colònia”, “cullera”, “escala”, “espill”, “esponja”, “flor”, “habitació”, “llavadora”, “llum”, “claus”, “medicina”, “mòbil”, “plat”, “porta”, “televisor”, “rellotge”, “cadira”, “sofà”, “telèfon”, “got”, “finestra”.

- Objectes i llocs fora de la casa. *Exemples*: “arbre”, “arena/terra”, “casa”, “carrer”, “gronxador”, “lluna”, “pluja”, “mar”, “parc”, “sol”, “tobogan”.

- Accions (verbs en qualsevol de les seues formes. Per exemple, del verm “anar”, el xiquet diu “va”, “anem” o “se n’ha anat”). *Exemples*: “obrir”, “caminar”, “apagar”, “ballar”, “baixar(se)”, “banyar(se)”, “beure”, “cantar”, “caure”, “sopar”, “dinar”, “córrer”, “agafar”, “menjar(se)”, “tancar”, “obrir”, “donar”, “(a)dormir(se)”, “encendre”, “ensenyar”, “estar [estic, estàs...]”, “esperar(se)”, “anar(se’n) [vaig, vas, anem...]”, “jugar”, “plorar”, “mirar”, “pegar(se)”, “pentinar(se)”, “pintar”, “poder [pots...]”, “posar(se)”, “cremar”, “voler”, “llevar(se)”, “riure”, “ser [eres, és...], “pujar(se’n)”, “portar”, “acabar”, “tirar”, “tocar”, “tossir”.

- Qualitats (tant en masculí com en femení). *Exemples*: “apagat”, “bonic”, “calent”, “encès”, “enfadat”, “malaltet”, “lleig”, “gelat”, “gran”, “guapo”, “fam”, “net”, “ple”, “dolent”, “xicotet”, “roí”, “trencat”, “set”, “son”, “brut”, “buit”.

- Temps. *Exemples*: “ara”, “després”, “dia”, “demà”, “nit”, “matí”, “vesprada (per la)”, “ja”.

- Pronoms i determinants. *Exemples*: “eixe/eixa/això”, “açò”, “meu/a”, “un altre/a”, “(per a) mi”, “jo”, “tu/teu”, “este/a”.

- Preguntes. *Exemples*: “com”, “quin/a”, “on”, “per què”, “què”, “qui”.

- Preposicions i locatius. *Exemples*: “baix/avall”, “allí/a”, “ací”, “damunt/dalt”, “davant”, “dintre/dins”; “darrere”, “fora”, “per a”.

- Quantificadors. *Exemples*: “més”, “poc”, “tot/a/es/s”, “un/a”.

PART 2: Gestos i accions.

I. Gestos. Registre de gestos comunicatius. Inclou conductes com ara: Estendre el braç per a mostrar o donar un objecte, o per a arribar a ell i poder agafar-lo per ensenyar-lo; assenyalar amb el dit algun objecte perquè alguna cosa li ha interessat d’ell; dir adeu amb la mà; allargar els braços per a demanar que l’aixequen o l’agafen en braços; fer el gest de “no” o de “sí” amb el cap; fer el gest de “sshhh” (callar) amb el dit; llançar besets; estrènyer els llavis fent “mmmmm” quan menja alguna cosa que està bona; alçar els muscles o estendre les mans cap als costats per a dir “on està?” o “no està/se n’ha anat”; o cridar a algú amb el gest de “vine” amb la mà.

II. Jocs. Registre de preguntes amb resposta sí/no per a que els pares enregistren si juga a algun dels jocs que es mencionen. *Exemples*: “ball manetes”, “bim bom les campanes de Salom”, “balla balla sac de palla”, “gateta moixoia”, joc de la família amb els ditets, “mà morta”, “La barca puja i baixa”.

III. Accions. Accions de cura i autonomia diària. Els pares poden marcar amb una 'x' tant si el xiquet ho fa com si intenta fer-ho. *Exemples*: Menjar amb cullera o forqueta, beure d'un got o una tassa, pentinar-se, rentar-se les dents, assecar-se amb una tovalla, posar-se un barret, posar-se una sabata, posar-se una polsera, posar-se el telèfon a l'orella, tirar una pilota, empentar un camió o un cotxet de joguet.

IV. Accions amb un joguet en lloc d'un altre. Presència o no de joc simbòlic. Per exemple, agafar el comandament a distància posar-se'l a l'orella com si fora un telèfon o fer com a que un llapis és un avió.

FORMULARI 16-30 MESOS

Quant al segon quadernet, que s'empra amb xiquets d'entre 16 i 30 mesos, i que s'ha utilitzat per a l'avaluació de les habilitats del llenguatge a la visita dels 18 mesos, els apartats continguts són els següents:

PART 0: Vocalitzacions. Aquest primer apartat és un dels apartats, junt a "producció primerenca", que es manté del quadernet dels 8-15 mesos. Com hem dit, pregunta als pares sobre emissions dels seus fills, com ara: vocalitzacions que acompanyen a les primeres manifestacions referencials protoimperatives i protodeclaratives; protoconverses; desenvolupament segmental (balboteig canònic i variat); imitació de

paraula i d'entonació; vocalitzacions en contextos no comunicatius; desenvolupament suprasegmental (argot).

PART 1: Paraules.

II. Producció primerenca: És l'altre apartat que té també l'anterior quadernet i conforma un registre conductual d'habilitats generals de producció primerenca. Per exemple, demanar que se'ls diga el nom de les coses que veuen assenyalant amb el dit i dient "atò?" ("açò?"), o dir les coses o persones que van veient per casa, pel carrer.

III. Desenvolupament del llenguatge: Se centra en quin ha sigut el patró evolutiu en l'adquisició del llenguatge.

IV. Vocabulari (producció): Inventari de paraules tipus *checklist* sobre el qual els pares han de marcar les paraules que xiquet és capaç de dir. S'obté una mesura del nombre total de paraules que el xiquet és capaç de produir, és a dir, una mesura de vocabulari productiu total.

- Interjeccions i sons d'animals i coses. *Exemples*: "aúpa", "ai!", "beeee", "brumbrum (cotxe"), "piu piu", "miau", "gua-guáu", "pií-pií (cotxe)".

- Jocs, rutines i fórmules socials: *Exemples*: "a vore", "a vestir-se", "adeu", "espera", "hola", "no", "no hi ha", "pupa", "caca", "shh (a callar)", "per favor", "sí", "(ú, dos) i tres".

- Animals, de veritat o de joguet. *Exemples*: “cavall”, “porquet”, “conill”, “gallina”, “gat”, “formiga”, “lleó”, “mosca”, “mico”, “pardalet”, “gos”, “peix”, “tigre”, “vaca”, “pollet”.

- Persones. *Exemples*: “avia/iaia”, “avi/iaio”, “germana”, “germà”, “mamà/mami”, “nena”, “nene”, “nom propi* (nom d’una persona coneguda), “papà/papi”, “tata/teta” “tete”, “tia”.

- Parts del cos. *Exemples*: “panxa”, “bigot”, “boca”, “braços”, “cap”, “cul”, “dits”, “dents”, “llengua”, “nas”, “ulls”, “melic”, “orelles”, “cames”, “peus”.

- Joguets. *Exemples*: “baló”, “caixa”, “conte/llibre”, “foto (càmera)”, “futbol”, “globus”, “gol”, “joguet”, “llapis”, “nina”, “música”, “osset”, “paper”, “pilota”, “puzle”, “tambor”.

- Vehicles, de veritat o de mentida. *Exemples*: “avió”, “autobús”, “barco”, “bici”, “camió”, “cotxe”, “moto”, “tren”.

- Aliments i begudes. *Exemples*: “aigua”, “biberó”, “caramel”, “llet”, “carn/txitxa”, “xocolate”, “menjar”, “galeta”, “pa”, “creïlles”, “formatge”, “iogurt”, “suc”.

- Roba. *Exemples*: “abric”, “pitet”, “bota/es”, “bufanda”, “botó”, “calcetí/ns”, “camiseta”, “jaqueta”, “barret”, “jersei”, “pantaló/ns”, “bolquer”, “pijama”, “roba”, “sabata/es”.

- Objectes i llocs de la casa. *Exemples*: “banyera”, “fem”, “caixó”, “llit”, “pinta”, “raspall”, “xumet”, “cuina”, “colònia”, “cullera”, “escala”, “espill”, “esponja”, “flor”, “habitació”, “llavadora”, “llum”, “claus”, “medicina”, “mòbil”, “plat”, “porta”, “televisor”, “rellotge”, “cadira”, “sofà”, “telèfon”, “got”, “finestra”.

- Objectes i llocs fora de la casa. *Exemples*: “arbre”, “arena/terra”, “casa”, “carrer”, “gronxador”, “lluna”, “pluja”, “mar”, “parc”, “sol”, “tobogan”.

- Accions (verbs en qualsevol de les seues formes. Per exemple, del verm “anar”, el xiquet diu “va”, “anem” o “se n’ha anat”). *Exemples*: “obrir”, “caminar”, “apagar”, “ballar”, “baixar(se)”, “banyar(se)”, “beure”, “cantar”, “caure”, “sopar”, “dinar”, “córrer”, “agafar”, “menjar(se)”, “tancar”, “obrir”, “donar”, “(a)dormir(se)”, “encendre”, “ensenyar”, “estar [estic, estàs...]”, “esperar(se)”, “anar(se’n) [vaig, vas, anem...]”, “jugar”, “plorar”, “mirar”, “pegar(se)”, “pentinar(se)”, “pintar”, “poder [pots...]”, “posar(se)”, “cremar”, “voler”, “llevar(se)”, “riure”, “ser [eres, és...], “pujar(se’n)”, “portar”, “acabar”, “tirar”, “tocar”, “tossir”.

- Qualitats (tant en masculí com en femení). *Exemples*: “apagat”, “bonic”, “calent”, “encès”, “enfadat”, “malaltet”, “lleig”, “gelat”, “gran”, “guapo”, “fam”, “net”, “ple”, “dolent”, “xicotet”, “roí”, “trencat”, “set”, “son”, “brut”, “buit”.

- Temps. *Exemples*: “ara”, “després”, “dia”, “demà”, “nit”, “matí”, “vesprada (per la)”, “ja”.

- Pronoms i determinants. *Exemples*: “eixe/eixa/això”, “açò”, “meu/a”, “un altre/a”, “(per a) mi”, “jo”, “tu/teu”, “este/a”.

- Preguntes. *Exemples*: “com”, “quin/a”, “on”, “per què”, “què”, “qui”.
- Preposicions i locatius. *Exemples*: “baix/avall”, “allí/a”, “ací”, “damunt/dalt”, “davant”, “dintre/dins”; “darrere”, “fora”, “per a”.

- Quantificadors. *Exemples*: “més”, “poc”, “tot/a/es/s”, “un/a”.

V. Usos del llenguatge: Avalua l’ús del llenguatge el contextos concrets (absència, passat, futur i pregunta).

- Parlar d’allò absent. Parlar de persones o coses que no estan presents. Per exemple, demanar el joguet favorit o preguntar per una persona absent.

- Parlar del passat. Parlar de situacions passades. Per exemple, la visita al circ de fa uns dies.

- Parar del futur. Parlar de coses que encara no han ocorregut. Per exemple, de que anirem a vore la iaia.

- Fer preguntes.

PART 2: Gramàtica.

I. **Acabament de paraules:** Avaluació de la morfologia nominal (nombre, gènere, augmentatiu/diminutiu) i verbal (temps, persona).

II. **Verbs difícils:** Aquest apartat conté un llistat tipus *checklist* de verbs irregulars entre els quals els pares han de marcar aquells que usa el seu fill o filla.

III. **Paraules sorprenents:** Avalua el nivell de gramaticalització a partir de les ocasions en què es produeixen sobregeneralitzacions de las regles morfològiques. Els pares han d'elegir entre una llista de verbs, i les seues formes verbals on més habitualment els xiquets solen cometre aquets tipus d'errors.

IV. **Combinació de paraules:** Pregunta als pares sobre tres de les frases més habituals que diu el seu fill per extraure la mesura de la Longitud Mitjana de l'Enunciat (LME). Els pares han de proporcionar tres exemples de les frases més llargues que recorden que el seu fill

haja produït espontàniament en els últims dies. Han de ser frases produïdes espontàniament i no frases imitades, lletres de cançons, rimes o fórmules apreses de memòria.

V. Complexitat morfosintàctica: Cada ítem d'aquest apartat ofereix als pares la possibilitat de escollir entre tres nivells de complexitat: el pre-gramatical, l'intermedi (*fillers*, parla semàntica ...) i el gramatical. Els ítems gramaticals venen presentats en el seu context quotidià d'emissió i estan ordenats evolutivament. Els primers ítems comencen amb els primers esforços gramaticals dels xiquets al voltant de la construcció de l'oració simple: concordança de gènere, marcatge verbal de temps i persona, clítics, preposicions, fórmules possessives i imperatives. Els ítems finals reflecteixen la continuació del desenvolupament gramatical, l'oració composta (coordinació i subordinació).

Exemples:

> A la pregunta "Què és això?", el xiquet contesta (1) "Cotxe", (2) "U cotxe", (3) "Un cotxe".
>
> A la pregunta "Què fa la iaia?", el xiquet contesta (1) "Iaia aigua", (2) "Iaia [ona] *dona* aigua", (3) "La Iaia em dona aigua".
>
> A la pregunta "De qui és aquest rellotge?", el xiquet contesta (1) "Papà", (2) "E papà", (3) "De papà".

A la pregunta “Vols eixir al carrer?”, el xiquet contesta (1) “Carrer no”, (2) “A carrer no”, (3) “Al carrer no”.

A la pregunta “T’agrada la nina?”, el xiquet contesta (1) “[apa] *Guapa*”, (2) “Nina guapa”, (3) “La nina és molt guapa”.

Al final de cada quadernet s'inclou una enquesta per a obtindré informació general sobre el xiquet i la seua família, i una fitxa de resultats per a que emplene el professional que administra l'instrument, amb puntuacions directes i percentils obtinguts. Per a l’obtenció dels percentils, el manual compta amb els barems corresponents per a cada apartat de l’instrument i cada edat. Així mateix, els barems estan classificats per sexe (xiquets i xiquetes). D’altra banda, també s’inclou una baremació que combina ambdós sexes, que s’utilitza habitualment per a finalitats d’investigació.

Els estudis conduïts per a testar la fiabilitat inter-jutges de el MCDI demostren que l’índex d’acord inter-jutges és alt, amb un valor de Kappa del .736 (López Ornat et al., 2005). És a dir, el protocol d’observació utilitzat constitueix una mesura bastant fiable de la conducta observada. Així mateix, els estudis conduïts per testar la validesa concurrent demostren que els índexs en aquest sentit són també adequats (Dale, Bate, Reznik, & Morisset, 1989; López Ornat et al., 2005). Per al testat de la validesa concurrent, es realitzaren en aquest estudi una sèrie gravacions de vídeo de les conductes comunicatives dels xiquets participants i es codificaren aquestes

conductes. Després, es compararen els resultats d'aquestes observacions amb les puntuacions que els pares havien donat en aquestes mateixes dimensions emprant el MCDI. Les correlacions entre les puntuacions obtingudes en l'apartat de Vocalitzacions, completada pels pares, i el protocol d'observació directa fou de .518 (López Ornat et al., 2005). Els autors dels estudis expliquen que és una correlació baixa però això que podia estar donant-se perquè és difícil que es donen totes les conductes vocalitzants que un xiquet és capaç de realitzar en un context d'observació en laboratori. Per tant, tot i que en la sessió en vídeo no apareix el balboteig variat, és altament probable que el xiquet el produïsca en altres situacions de la seua vida quotidiana, tal com informen els seus pares. Per contra, en l'apartat de Gramàtica, la validesa concurrent entre les puntuacions dels pares i les puntuacions del protocol d'observació fou alta, amb un .873 de valor de la correlació. Finalment, en les mostres de Llenguatge Productiu Espontani, l'índex Kappa va resultar ser de .652, és a dir, moderat (López Ornat et al., 2005).

Per al càlcul de la validesa predictiva, estudis anteriors han optat per prendre mesures repetides amb un interval de 2 a 5 mesos des de la primera aplicació dels inventaris a les posteriors. Els valors per a cada apartat foren, en aquestos estudis, de .92 per a Vocalitzacions i de .83 per a Producció de Paraules. A més a més, les correlacions trobades entre Producció de Paraules i els altres apartats dels inventaris en aplicacions posteriors se situen totes en valors iguals o superiors a 0.80

i són totes significatives. Per tant, el Vocabulari Productiu sembla ser un bon índex de predicció sobre si mateix i sobre els altres components dels inventaris. En últim lloc, la mesura de Complexitat Morfosintàctica presenta un alt valor predictiu sobre sí mateixa, però no sobre altres components de l'inventari (López Ornat et al., 2005).

El MCDI s'ha emprat en el present treball per a l'avaluació de les *habilitats del llenguatge als 12 mesos* i les *habilitats dels llenguatge als 18 mesos*. Les variables incloses en **habilitats del llenguatge als 12 mesos** són les següents: *vocalitzacions* (VOC12), *comprensió de paraules* (*word comprehension*; WC12), p*roducció de paraules* (*word production*; WP12), i *gestos i accions* (GA12). La variable VOC12 naix de l'apartat "Part 0: Vocalitzacions" del formulari 8-15 del MCDI. La variable WC12 s'extrau de la puntuació del xiquet en "Comprensió de paraules", dintre de l'apartat "Vocabulari" que el MCDI formulari 8-15 inclou a l'apartat anomenat "Part 1: Primeres paraules". La variable WP12 s'extrau de la puntuació del xiquet en "Producció de paraules", dintre d'aquesta mateixa secció de "Vocabulari" del formulari 8-15 del MCDI. Finalment, la variable GA12 equival a la suma de l'apartat que l'instrument anomena "Part 2: Gestos i accions".

Les variables incloses en **habilitats del llenguatge als 18 mesos** són les següents: v*ocalitzacions* (VOC18), *producció de paraules* (*word production*; WP18), a*cabament de paraules* (*word ending*; WEND18), i c*omplexitat morfosintàctica* (*morphosyntactic complexity*; MSYC18). La variable VOC18 equival a l'apartat anomenat "Part 0: Vocalitzacions" de

l'inventari 16-30 del MCDI. La variable WP18 naix de l'apartat "Part 1: Paraules" que aquest mateix instrument anomena "Vocabulari". La variable WEND18 equival a l'apartat de "Acabament de paraules" inclosa en la secció anomenada "Part 2: Gramàtica". Finalment, la variable MSYC18 s'extrau d'una de les parts d'aquesta mateixa secció ("Part 2: Gramàtica") que s'anomena "Complexitat morfosintàctica".

Finalment, a la taula 8 es presenta un esquema que mostra d'una manera sintetitzada els moments d'avaluació, i els instruments que s'han emprat per avaluar les variables en cada moment:

Table 8. Summary outline of the assessment moments and the instruments used for each moment and each variable

	INSTRUMENTS PER EDATS		
VARIABLES	8 mesos	12 mesos	18 mesos
Habilitats de la comunicació social primerenca. IJAL IJAH RJAD RJAP IBRL IBRH RBRT ISI RSIT	ESCS	ESCS	ESCS
Habilitats del llenguatge. VOC18 i VOC12 WC12 GA12 WP12 i WP18 WEND18 MSYC18		MCDI	MCDI
Signes primerencs de TEA		FYI (RISK12)	M-CHAT (RISK18)

6. 6. Procediment

Aquesta tesi s'emmarca dintre d'un estudi longitudinal més ampli que incorpora, a més dels tres moments d'avaluació que conformen el present estudi, les avaluacions als 24, 30 i 36 mesos. En aquestes avaluacions, s'inclouen mesures d'habilitats del llenguatge més específiques, com ara la pragmàtica, i altres aspectes de desenvolupament cognitiu. No obstant, per a la descripció del procediment, ens centrarem en descriure com s'ha realitzat l'obtenció de les dades en els moments que s'inclouen al present treball (8, 12 i 18 mesos) i descriurem com és una sessió típica completa.

Cadascuna de les sessions d'avaluació té lloc en els laboratoris de recerca de la Facultat de Psicologia per tal de garantir que les avaluacions es realitzen en una situació controlada que és igual per a tots els subjectes. Cada sessió d'avaluació té una durada d'aproximadament una hora i mitja, dividida en quatre parts:

1. Entrevista amb la mare o el pare (15 minuts). Dades sociodemogràfiques (annex III) i *Consentiment Informat* (annex II) [Només en la primera visita].
2. Joc lliure amb la mare o el pare (10 minuts).
3. Avaluació amb l'examinador (30 minuts). ESCS (Mundy et al., 2003): Atenció conjunta, conducta de demanda i interacció social.
4. Qüestionaris als pares (20 minuts)

Cada sessió d'avaluació comença amb la rebuda de les famílies a l'hora pactada al hall de la Facultat. A continuació, se'ls acompanya fins a la sala on es realitzaran les proves i se'ls demana que emplenen els qüestionaris. A la sala, la diada és convidada a passar mentre que a la resta d'acompanyants se'ls explica que no poden estar a la sala d'avaluació mentre que té lloc la sessió però que poden observar el transcurs de la mateixa des d'una altra sala adjacent a la sala principal i a través de l'espill unidireccional que aquesta sala té instal·lat. Per tant, a la sala d'avaluació solament hi entren el cuidador i el bebè, a més de l'examinador.

Les sessions han de ser gravades en vídeo, ja que alguns dels instruments emprats són de registre observacional que requereixen la codificació posterior de les conductes rellevants. Per tractar-se de conductes centrades en el rostre del bebè, es necessita que la imatge siga nítida, per la qual cosa no es pot manipular la imatge per evitar la identificació del subjecte. Les dades, tant d'imatge i so, com dels qüestionaris, es custodien d'acord amb la normativa vigent sobre protecció de dades de caràcter personal (LO 15/1999). De tot açò s'informa complidament al familiar i així consta en el *Consentiment Informat* (annex II).

6. 7. Hipòtesis

A. Alguns treballs anteriors apunten al fet de que mesures com ara l'IJA o la RJA es refereixen a processos cognitius distints i estan vinculats a l'activació de distintes àrees en el cervell (Salo et al., 2018; Vaughan Van Hecke et al., 2007). De la mateixa manera, altres treballs destaquen que mesures com l'IJAL o l'IJAH no estan relacionades (Pickard & Ingersoll, 2015). En base a aquestes investigacions prèvies, no esperem trobar relacions significatives entre les variables d'atenció conjunta. [Hipòtesi vinculada a l'objectiu 1]

B. Treballs anteriors destaquen el patró de creixement irregular d'IJA entre els 8 i els 18 mesos, amb un creixement dels 8 als 15 mesos, una baixada dels 15 als 18 mesos i una pujada de nou a partir dels 18 mesos (Ibáñez et al., 2013; Mundy et al., 2007; Sheinkopf et al., 2004). En la mateixa línia, s'espera que la trajectòria de les conductes d'IJA en els tres moments d'avaluació en el present treball (8 mesos, 12 mesos i 18 mesos), seguisca el següent patró: ascendent dels 8 als 12 mesos i lleugerament descendent dels 12 als 18 mesos. [Hipòtesi vinculada a l'objectiu 2]

C. Alguns treballs com ara el d'Ibáñez et al. (2013) o el de Yoder et al. (2009) posen de manifest com les diferències en algunes de les habilitats de comunicació primerenca als 8 mesos poden començar

a ser primers indicadors d'autisme, tot i que més l'absència d'aquestes conductes és l'evolució de les mateixes el que constituiria un indicador. Per tant, s'espera que les mesures d'habilitats de comunicació primerenca als 8 mesos no predisquen de manera significativa els primers signes de TEA als 12 i als 18 mesos. Però s'espera que aquestes mateixes mesures als 12 mesos sí que puguen predir significativament la simptomatologia primerenca de TEA als 18 mesos. S'espera que les variables d'atenció conjunta tinguen més poder predictiu que les variables de conducta de demanda sobre la presència de primers marcadors de TEA als 18 mesos. Aquesta idea es fonamenta en les investigacions que apunten que és en les conductes d'atenció conjunta on els xiquets amb risc presenten majors dificultats (Franchini et al., 2019; Schertz & Odom, 2007; Schertz et al., 2018). Específicament, s'espera que les mesures d'IJAH siguen les què tinguen major poder predictiu sobre la presència de primers marcadors de TEA als 18 mesos (Chiang et al., 2008; Pickard & Ingersoll, 2015). [Hipòtesi vinculada als objectius 3 i 4]

D. Treballs anteriors assenyalen que les conductes d'atenció conjunta (comunicació protodeclarativa) tenen una relació significativa amb el desenvolupament posterior del llenguatge (Colonnesi et al., 2010; Salo et al., 2019). En base a aquestos i a altres treballs (Lüke et al., 2017; Mundy et al., 2007; Smith, 2003), s'espera que les

variables d'atenció conjunta als 8 i als 12 mesos puguen predir les habilitats del llenguatge als 12 i als 18 mesos; i que les variables de conducta de demanda (comunicació imperativa) als 8 i als 12 mesos no tinguen poder predictiu sobre aquestes mateixes habilitats als 12 i als 18 mesos (Lüke et al., 2017). En concret, s'espera que les variables d'IJA es relacionen significativament amb aspectes del llenguatge productiu i que les variables de RJA, per la seua part, mostren una relació significativa amb les mesures de comprensió de paraules (Luyster & Lord, 2010; Maljaars et al., 2012; Salo et al., 2018; Thurm et al., 2007). [Hipòtesi vinculada a l'objectiu 5]

6. 8. Anàlisis

L'anàlisi de dades i l'obtenció de resultats s'han realitzat amb el programa d'anàlisi estadística SPSS, versió 24.0 (Cor, 2016). Les anàlisis que s'han dut a terme són: anàlisis descriptives, anàlisis correlacionals, MANOVA, regressions lineals múltiples i regressions logístiques. A continuació, s'especifiquen les anàlisis que s'han realitzat per a cada objectiu.

OBJECTIU 1: Analitzar com es relacionen les distintes habilitats de comunicació social primerenca en cadascun del tres moments evolutius (8, 12 i 18 mesos), en una mostra de xiquets nascuts a la província de València.

Per a l'anàlisi vinculat a l'objectiu 1 s'han realitzat *correlacions de Spearman.* L'elecció d'aquesta prova no paramètrica respon al fet que no totes les variables d'habilitats de comunicació primerenca en els tres moments d'avaluació tenen una distribució normal en les seues puntuacions. Les anàlisis s'han realitzat atenent a cada moment d'avaluació que conforma el disseny longitudinal del present treball (8, 12 i 18 mesos). És a dir, s'ha dut a terme una anàlisi de correlació per a cada moment d'avaluació.

OBJECTIU 2: Analitzar l'evolució de les distintes habilitats de comunicació social primerenca a través dels tres moments evolutius (8, 12 i 18 mesos), en un grup de xiquets nascuts a la província de València.

Per a l'anàlisi vinculada a l'objectiu 2, de tipus longitudinal, s'han dut a terme *models d'anàlisis múltiples de variància (MANOVA)*, per a comparar cadascuna de les variables d'habilitats de la comunicació social primerenca en els tres moments d'avaluació (8, 12 i 18 mesos).

OBJECTIU 3: Analitzar la capacitat predictiva de les habilitats de comunicació social primerenca als 8 mesos sobre els marcadors primerencs de TEA als 12 mesos, en un grup de xiquets nascuts a la província de València.

Per a l'anàlisi vinculada a l'objectiu 3 s'han realitzat *regressions lineals múltiples* per tal d'explorar la capacitat predictiva de les habilitats de la comunicació social primerenca als 8 mesos sobre la puntuació de l'instrument *First Year Inventory* (FYI) (Baranek et al., 2003), que determina el grau de presència de primers marcadors de TEA. S'han realitzat les anàlisis organitzant-les en tres grans categories, atenen a les tres dimensions de comunicació social primerenca que articulen el present treball: atenció conjunta, conducta de demanda i interacció social.

OBJECTIU 4: Analitzar la capacitat predictiva de les habilitats de comunicació social primerenca als 8 i als 12 mesos sobre la presència de primers marcadors de TEA als 18 mesos, en un grup de xiquets nascuts a la província de València.

Per a explorar la relació entre les habilitats de comunicació social primerenca i els primers marcadors de TEA als 18 mesos s'han realitzat *anàlisis de regressió logística*, vist la puntuació que s'obté amb l'instrument que identifica els primers marcadors de TEA —el

Qüestionari de Autisme a la Infància-Modificat (M-CHAT) (Robins et al., 2001)— és una puntuació categorial de tipus risc/no risc.

OBJECTIU 5: Explorar la relació entre les habilitats de comunicació social primerenca als 8 mesos amb la competència lingüística als 12 mesos, i la relació entre les habilitats de comunicació social primerenca als 8 i als 12 mesos amb la competència lingüística als 18 mesos.

Per a l'anàlisi vinculada a l'objectiu 5 s'han realitzat *regressions linears múltiples*, per tal de valorar com es relacionen les distintes habilitats de comunicació primerenca als 8 i als 12 mesos amb les habilitats del llenguatge als 12 i als 18 mesos. S'han realitzat regressions múltiples per analitzar en quina mesura les habilitats de la comunicació social primerenca als 8 mesos prediuen el rendiment de distints aspectes del llenguatge als 12 mesos; i en quina mesura les habilitats de la comunicació social primerenca als 12 mesos prediuen el rendiment de distints aspectes del llenguatge als 18 mesos.

CHAPTER 7: Resultats

El capítol de resultats s'organitza seguint l'ordre dels objectius presentats. Per tant, aquest capítol està dividit en 5 grans apartats que, a la vegada, estan dividits en tants subapartats com ha resultat necessari per a cobrir tot el que especifica cada objectiu en cada cas.

7. 1. Relació entre les habilitats de comunicació social primerenca en cadascun del tres moments evolutius.

Aquesta secció està vinculada al primer objectiu del present treball, que pretén analitzar com es relacionen les distintes habilitats de comunicació social primerenca en cada moment d'avaluació de la mostra: els 8, els 12 i els 18 mesos. Per a la consecució d'aquest objectiu, s'han realitzat anàlisis de correlacions bivariades.

7. 1. 1. Anàlisi correlacional de les variables d'habilitats de comunicació social primerenca als 8 mesos.

Previ a la realització de les correlacions bivariades entre les variables d'habilitats de comunicació social primerenca als 8 mesos, s'ha realitzat una prova de normalitat per a explorar la distribució de les puntuacions en cadascuna de les variables amb les quals s'ha volgut

fer les correlacions. Per a això, s'ha utilitzat la prova de Komogorov-Smirnov, vist que el grup de participants dels 8 mesos supera els 50 subjectes (N = 52). Per a la realització d'aquesta anàlisi s'han eliminat les variables RBRH8 i RBRT8, perquè són variables que no presenten variabilitat en les seues puntuacions als 8 mesos. Ambdues fan referència a conductes que no solen estar presents encara en edats tan primerenques com els 8 mesos, i la gran majoria de les seues puntuacions són zero. Així mateix, aquestes variables han sigut eliminades de l'anàlisi de correlació. Els resultats de la prova de normalitat de Komogorov-Smirnov es troben a la taula 9.

Table 9. Normality test for early social communication variables at 8 months

Prova de Kolmogorov-Smirnov per a una mostra

	IJAL8	IJAH8	RJAP8	RJAD8	IBRL8	IBRH8	RBRT8	ISI8	RSIT8
N		52	52	52	52	52	52	52	52
Mitjana	14.75	0.23	71.49	11.59	7.96	0.08	0.58	0.85	4.94
Desviació Típica	9.14	0.73	28.77	18.24	4.31	0.55	4.16	2.40	1.93
Estadístic	0.137	0.489	0.166	0.334	0.150	0.536	0.536	0.445	0.208
Sig.	.015[a]	<.001[a]	.001[a]	<.001[a]	.005[a]	<.001[a]	<.001[a]	<.001[a]	<.001[a]

a. Correcció de significació de Lilliefors

El supòsit de normalitat no es compleix en cap dels casos. Ninguna de les variables d'habilitats de comunicació social primerenca als 8 mesos té una distribució normal en les seues puntuacions. Per tant, s'ha optat per la utilització d'una prova no paramètrica per a la realització de les correlacions bivariades entre les variables d'habilitats de la comunicació social primerenca als 8 mesos. La prova escollida ha estat la correlació de Spearman. Els resultats es presenten a la taula 10.

Table 10. Bivariate correlations between early social communication variables at 8 months

Correlacions Bivariades Rho de Spearman

		IJAL8	IJAH8	RJAP8	RJAD8	IBRL8	ISI8	RSIT8
IJAL8	Rho	1.000						
	Sig.							
	N	52						
IJAH8	Rho	**.353***	1.000					
	Sig.	.010						
	N	52	52					
RJAP8	Rho	**.273***	**.413****	1.000				
	Sig.	.050	.002					
	N	52	52	52				
RJAD8	Rho	-.058	.196	.257	1.000			
	Sig.	.681	.163	.066				
	N	52	52	52	52			
IBRL8	Rho	**.334***	-.036	.047	.148	1.000		
	Sig.	.015	.800	.740	.295			
	N	52	52	52	52	52		
ISI8	Rho	.193	.215	.106	.025	.049	1.000	
	Sig.	.170	.126	.455	.862	.733		
	N	52	52	52	52	52	52	
RSIT8	Rho	.234	.197	.086	.026	.177	**.392****	1.000
	Sig.	.095	.161	.543	.854	.210	.004	
	N	52	52	52	52	52	52	52

* La correlació és significativa al nivell .05 (bilateral)

** La correlació és significativa al nivell .01 (bilateral)

S'observen correlacions estadísticament significatives entre algunes de les variables d'habilitats de comunicació social primerenca als 8 mesos.

Destaca que l'inici d'atenció conjunta de baix nivell correlaciona significativament amb la seua anàloga d'alt nivell (IJAL8 - IJAH8; *rho* = .353). És a dir, a major ús de conductes com ara el contacte visual o l'alternança de mirada, ús més freqüent de conductes com ara assenyalar per a compartir interès. De la mateixa manera, destaca la relació entre les variables IJAL8 i IBRL8 (*rho* = .334), que són dues

variables que pertanyen a dimensions diferents —atenció conjunta i conducta de demanda— però que se situen en el mateix nivell evolutivament. Ambdues són variables de baix nivell, és a dir, que els xiquets adquireixen de manera més primerenca perquè són conductes més bàsiques evolutivament. La correlació significativa entre aquestes variables podria estar justificant el fet que IJAL i IBRL fan referència a la mateixa conducta (contacte visual o alternança de mirada) emprada amb finalitats comunicatives distintes (comunicació declarativa i comunicació imperativa, respectivament).

Un altre resultat destacable que observem als 8 mesos, comparable a la relació entre l'IJAL8 i l'IBRL8, seria la relació estadísticament significativa entre les variables IJAL8 i RJAP8. Aquestes són dues variables de baix nivell pertanyents a la mateixa dimensió d'atenció conjunta, una en forma d'inici i l'altra en forma de resposta. Les dues fan referència a la mateixa conducta emprada en situacions diferents. La conducta d'IJAL es refereix a l'ús de l'alternança de mirada com una manera d'iniciar un episodi d'atenció compartida, mentre que la RJAP es refereix a l'alternança de mirada com a forma de resposta a una invitació a l'atenció compartida. Aquesta correlació significativa entre l'IJAL8 i la RJAP8 apareix també als 18 mesos, encara que no s'hi observa als 12.

Per últim, destaca la correlació estadísticament significativa entre les dues variables d'interacció social, en inici d'interacció social i en resposta d'interacció social (ISI8 - RSIT8; *rho* = .392). Aquestes són

variables que es refereixen a dues qüestions molt relacionades: iniciar una conducta i respondre a la invitació a participar en eixa mateixa conducta. Per exemple, passar una pilota a algú com indicant la voluntat d'iniciar un joc de torns o tornar la pilota a algú que ja te l'ha passada inicialment.

7. 1. 2. Anàlisi correlacional de les variables d'habilitats de comunicació social primerenca als 12 mesos.

Igualment com s'ha fet amb les anàlisis de l'anterior apartat, previ a la realització de les correlacions bivariades, s'ha realitzat una prova de normalitat per a explorar la distribució de les puntuacions. En aquest cas, s'ha utilitzat la prova de Shapiro-Wilk perquè el grup de participants dels 12 mesos no supera els 50 subjectes (N = 45). Els resultats d'aquesta prova es troben a la taula 11.

Aquesta vegada, sí que s'han inclòs les variables d'IBRH12 i RBRT12 perquè són variables que sí que tenen variabilitat. Aquestes variables fan referència a unes conductes que comencen a manifestar-se a l'any de vida. És per això que s'han inclòs en les anàlisis dels 12 mesos i també en les anàlisis dels 18 mesos.

Table 11. Normality test for early social communication variables at 12 months

Prova de Shapiro-Wilk per a una mostra

	IJAL12	IJAH12	RJAP12	RJAD12	IBRL12	IBRH12	RBRT12	ISI12	RSIT12
N	44	44	44	44	44	44	44	44	44
Mitjana	15.16	5.60	80.08	66.85	9.87	7.62	47.18	2.62	8.33
Desviació Típica	7.33	5.86	27.45	27.08	4.08	6.72	32.48	2.85	2.15
Estadístic	0.948	0.851	0.744	0.912	0.974	0.892	0.934	0.804	0.907
Sig.	.046 [a]	.000 [a]	.000 [a]	.003 [a]	**.431** [a]	.001 [a]	.014 [a]	<.001 [a]	.002 [a]

a. Correcció de significació de Lilliefors

El supòsit de normalitat només es compleix en el cas de la variable IBRL12. Només aquesta variable té una distribució normal en les seues puntuacions. Per tant, s'ha optat per la utilització d'una prova no paramètrica per a la realització de les correlacions bivariades entre les variables d'habilitats de la comunicació social primerenca també als 12 mesos. La prova escollida ha estat la correlació de Spearman. Els resultats es troben a la taula 12.

Table 12. Bivariate correlations between early social communication variables at 12 months

Correlacions Bilaterals Rho de Spearman

		IJAL12	IJAH12	RJAP12	RJAD12	IBRL12	IBRH12	RBRT12	ISI12	RSIT12
IJAL12	Rho	1.000								
	Sig.									
	N	45								
IJAH12	Rho	**-.379***	1.000							
	Sig.	.010								
	N	45	45							
RJAP12	Rho	-.153	.002	1.000						
	Sig.	.317	.991							
	N	45	45	45						
RJAD12	Rho	-.120	.188	**.385****	1.000					
	Sig.	.439	.221	.010						
	N	44	44	44	44					
IBRL12	Rho	.244	-.232	.072	-.020	1.000				
	Sig.	.106	.124	.640	.895					
	N	45	45	45	44	45				
IBRH12	Rho	.048	**.372***	.138	**.346***	-.011	1.000			
	Sig.	.753	.012	.367	.021	.945				
	N	45	45	45	44	45	45			
RBRT12	Rho	-.158	.237	.216	.201	.226	**.341***	1.000		
	Sig.	.300	.117	.154	.191	.135	.022			
	N	45	45	45	44	45	45	45		
ISI12	Rho	-.163	.170	.017	.024	.209	-.046	-.056	1.000	
	Sig.	.285	.265	.910	.877	.169	.762	.717		
	N	45	45	45	44	45	45	45	45	
RSIT12	Rho	.170	.191	**.311***	.236	.229	.239	**.435****	.2888	1.000
	Sig.	.263	.208	.037	.123	.130	.115	.003	.054	
	N	45	45	45	44	45	45	45	45	45

* La correlació és significativa al nivell .05 (bilateral)

** La correlació és significativa al nivell .01 (bilateral)

Als 12 mesos, trobem que hi ha correlacions estadísticament significatives que es mantenen o que són semblants a algunes de les correlacions dels 8 mesos.

Seguint la mateixa tendència dels 8 mesos, destaca la relació entre variables pertanyents dimensions diferents tot i sent del mateix nivell evolutivament. Hem vist com als 8 mesos s'hi observa una correlació

estadísticament significativa entre les variables IJAL8 i IBRL8 (*rho* = .334). Als 12 mesos trobem un fet similar, amb la correlació estadísticament significativa entre les seues anàlogues d'alt nivell: les variables IJAH12 i IBRH12 (*rho* = .372). De nou, són dues variables pertanyents a dimensions diferents —atenció conjunta i conducta de demanda— però que comparteixen el mateix nivell de complexitat en quant a desenvolupament es refereix. És a dir, IJAH i IBRH són la mateixa conducta (assenyalar, donar, mostrar) emprada amb la finalitats diferents (compartir interès per alguna cosa o sol·licitar alguna cosa).

Així mateix, s'hi repeteix una altra tendència que ja havíem observat als 8 mesos i és la correlació estadísticament significativa entre variables d'una mateixa dimensió en les seues versions d'alt i de baix nivell. D'una banda, així com als 8 mesos l'atenció conjunta de baix nivell correlaciona positivament amb la seua anàloga d'alt nivell (IJAL8 - IJAH8; *rho* = .353), als 12 mesos, trobem que l'atenció conjunta de baix nivell correlaciona també amb la seua anàloga d'alt nivell, aquesta vegada negativament IJAL12 i IJAH12 (*rho* = -.379). És a dir, a major ús de conductes com ara el contacte visual o l'alternança de mirada, ús menys freqüent de conductes com ara assenyalar per a compartir interès. D'altra banda, s'hi observa una correlació estadísticament significativa entre la RJAP12 i la seua anàloga d'alt nivell, la RJD12 (*rho* = .385). Aquesta relació entre les dues vessants de la resposta d'atenció conjunta, la resposta proximal i la resposta distal, no s'hi troba als 8

mesos i és als 12 mesos quan comencem a poder-la observar. Per últim, destaca la correlació estadísticament significativa entre dues conductes que ocorren en forma de resposta i són la RBRT12 i la RSIT12 (*rho* = .435).

7. 1. 3. Anàlisi correlacional de les variables d'habilitats de comunicació social primerenca als 18 mesos.

En darrer lloc, s'han portat a terme les anàlisis de correlació per a les variables d'habilitats de comunicació social primerenca als 18 mesos. Tal i com s'ha fent amb els casos anteriors, previ a la realització de les correlacions, s'ha realitzat una prova de normalitat per a explorar la distribució de les puntuacions en cadascuna de les variables amb les quals s'ha volgut fer les correlacions. En aquest cas, s'ha utilitzat també la prova de Shapiro-Wilk perquè el grup de participants dels 18 mesos no supera els 50 subjectes (N = 30). Els resultats d'aquesta prova es troben a la taula 13.

Table 13. Normality test for early social communication variables at 18 months

Prova de Shapiro-Wilk per a una mostra

	IJAL18	IJAH18	RJAP18	RJAD18	IBRL18	IBRH18	RBRT18	ISI18	RSIT18
N	30	30	30	30	30	30	30	30	30
Mitjana	13.47	8.80	91.94	86.67	5.43	11.77	70.89	2.77	8.63
Desviació Típica	8.178	5.921	20.286	21.002	3.803	7.578	28.549	2.555	2.871
Estadístic	0.922	0.937	0.468	0.690	0.913	0.956	0.880	0.769	0.944
Sig.	.031[a]	**.078**[a]	<.001[a]	<.001[a]	.018[a]	**.244**[a]	.003[a]	<.001[a]	**.119**[a]

a. Correcció de significació de Lilliefors

En el cas de les variables de comunicació social primerenca als 18 mesos, el supòsit de normalitat només es compleix en el cas de les variables IJAH18, IBRH18 i RSIT18. Per tant, s'ha optat per la utilització d'una prova no paramètrica (correlació de Spearman) per a l'anàlisi de correlacions amb les variables de comunicació social primerenca als 18 mesos. Els resultats estan a la taula 14.

Table 14. Bivariate correlations between early social communication variables at 18 months

Correlacions Bilaterals Rho de Spearman

		IJAL18	IJAH18	RJAP18	RJAD18	IBRL18	IBRH18	RBRT18	ISI18	RSIT18
IJAL18	Rho	1.000								
	Sig.									
	N	30								
IJAH18	Rho	.217	1.000							
	Sig.	.248								
	N	30	30							
RJAP18	Rho	**.384***	.353	1.000						
	Sig.	.036	.055							
	N	30	30	30						
RJAD18	Rho	**.395***	.017	**.431***	1.000					
	Sig.	.031	.929	.017						
	N	30	30	30	30					
IBRL18	Rho	.356	-.070	.292	**.593****	1.000				
	Sig.	.054	.713	.118	.001					
	N	30	30	30	30	30				
IBRH18	Rho	.219	.270	**.497****	.069	.308	1.000			
	Sig.	.245	.149	.005	.719	.098				
	N	30	30	30	30	30	30			
RBRT18	Rho	.208	.218	**.440***	.318	.187	.270	1.000		
	Sig.	.271	.247	.015	.087	.321	.149			
	N	30	30	30	30	30	30	30		
ISI18	Rho	-.089	-.176	.035	.207	.146	.035	.025	1.000	
	Sig.	.639	.351	.855	.273	.443	.855	.897		
	N	30	30	30	30	30	30	30	30	
RSIT18	Rho	.160	**.430***	.279	.328	.140	-.032	.094	.0239	1.000
	Sig.	.398	.018	.135	.077	.460	.868	.621	.900	
	N	30	30	30	30	30	30	30	30	30

* La correlació és significativa al nivell .05 (bilateral)

** La correlació és significativa al nivell .01 (bilateral)

Destaca que, aquella correlació estadísticament significativa entre IJAL i IJAH que trobem als 8 i als 12 mesos, ja no es dona als 18 mesos. No obstant, en trobem altres de notables, com ara la relació entre variables que se situen al mateix nivell evolutiu o la relació entre variables dintre de la mateixa dimensió. Observem correlacions estadísticament significatives entre l'IJAL18 i la RJAP18 (*rho* = .384), ambdues variables de baix nivell dintre de la dimensió d'atenció conjunta; i entre la RJAP18 i la RJAD18 (*rho* = .431), ambdues variables de la conducta de resposta d'atenció conjunta. A més a més, destaca que aquesta relació estadísticament significativa entre RJAP18 i RJAD18 (*rho* = .431) és observable també als 12 mesos, mentre que als 8 mesos no ho és. Finalment, destaca que la variable RJAP18 manté correlacions estadísticament significatives amb diverses variables als 18 mesos, sent la variable amb major nombre de relacions significatives en aquest moment d'avaluació.

En conjunt, les variables d'IJAL i de RJAP són les variables amb major nombre de correlacions significatives en els tres moments d'avaluació.

7. 2. Exploració del curs evolutiu de les habilitats de comunicació social primerenca a través dels tres moments d'avaluació.

En aquest apartat, s'exposaran, en primer lloc, els resultats de l'anàlisi descriptiva de les distintes variables d'habilitats de comunicació

social primerenca en els tres moments d'avaluació (8, 12 i 18 mesos). Seguidament, es presentaran els resultats obtinguts a les MANOVA, que s'han realitzat després de les anàlisis descriptives.

Les MANOVA s'han fet separadament per a cada grup d'habilitats de comunicació social primerenca —atenció conjunta, conducta de demanda i interacció social—. Les anàlisis s'han fet amb 28 subjectes, que són els subjectes dels quals es tenen resultats en tots tres moments (als 8, als 12 i als 18 mesos).

7. 2. 1. Curs evolutiu de les habilitats d'atenció conjunta.

S'exposarà, primerament, la informació descriptiva de les variables d'atenció conjunta en cada moment d'avaluació. Els estadístics descriptius per a les variables d'atenció conjunta en els tres moments es troben a la taula 15.

Table 15. Descriptive statistics of joint attention variables for the longitudinal analysis

Estadístics descriptius			
	Mitjana	Desv. Típica	N
IJAL8	13.86	8.64	28
IJAL12	13.82	6.77	28
IJAL18	13.21	8.26	28
IJAH8	0.18	0.61	28
IJAH12	5.75	5.18	28
IJAH18	8.46	5.41	28
RJAP8	70.46	27.04	28
RJAP12	77.81	28.82	28
RJAP18	92.80	20.03	28
RJAD8	14.29	19.46	28
RJAD12	68.90	27.09	28
RJAD18	85.71	21.44	28

L'evolució de les variables d'inici d'atenció conjunta (IJA) es troba representada a la figura 16, i l'evolució de les variables de resposta d'atenció conjunta (RJA) es troba representada a la figura 15.

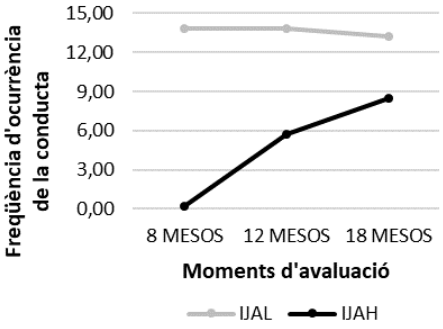

Figure 16. Growth pattern of IJA variables.

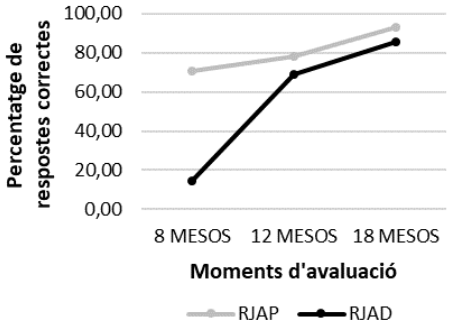

Figure 15. Growth pattern of RJA variables.

Abans de la realització de les MANOVA, s'ha comprovat l'esfericitat de les variables. Per a això s'ha realitzat la prova de Mauchly (taula 16).

Table 16. Sphericity test of joint attention variables for the longitudinal analysis

Prova d'esfericitat de Mauchly[a]

	W de Mauchly	Aprox. Chi-quadrat	gl	Sig.	Épsilon[b] Greenhouse-Geisser	Huynh-Feldt	Límit inferior
IJAL	.843	4.446	2	**.108**	.864	.918	0.500
IJAH	.982	0.472	2	**.790**	.982	1.000	0.500
RJAP	.620	12.429	2	.002	.725	.755	0.500
RJAD	.908	2.500	2	**.287**	.916	.979	0.500

a. Disseny: Intersecció

b. Es pot utilitzar per ajustar els graus de llibertat per a les proves mitjana de significació

Els resultats de les MANOVA amb les variables d'atenció conjunta han revelat diferències estadísticament significatives [Wilk's Lambda (λ) = .046; $F(4,24) = 125.095$; $p = < .001$; $\eta^2 p = .954$]. Les diferències foren significatives per les variables IJAH, RJAP i RJAD (taula 17).

Table 17. Repeated measures MANOVA with joint attention variables

Proves univariades

		Tipus IV de suma de quadrats	gl	Mitjana quadràtica	F	Sig.	Eta parcial al quadrat	Paràmetre sense centralitat	Potència observada[a]
IJAL	Esfericitat assumida	7.310	2	3.655	0.108	.898	.004	0.215	0.066
IJAH	Esfericitat assumida	999.238	2	499.619	37.466	**<.001**	.581	74.933	1.000
RJAP	Huynh-Feldt	7259.286	1.51	4807.700	7.822	**.003**	.225	11.810	0.883
RJAD	Esfericitat assumida	78093.972	2	39046.986	94.866	**<.001**	.778	189.733	1.000

a. S'ha calculat utilitzant alpha = .05

A continuació, s'hi inclouen els resultats de les comparacions per parells entre els moments d'avaluació per a cada variable d'atenció conjunta (taula 18).

Table 18. Pairwise MANOVA comparisons with joint attention variables - Bonferroni adjust

Comparacions per parells

		Diferència de mitjanes (I-J)	Desv. Error	Sig.[b]	95% d'interval de confiança per a diferència[b] Límit inferior	Límit superior
IJAL	8MESOS-12MESOS	0.036	1.777	1.000	-4.500	4.571
	12MESOS-18MESOS	0.607	1.233	1.000	-2.539	3.753
	8MESOS-18MESOS	0.643	1.613	1.000	-3.474	4.759
IJAH	8MESOS-12MESOS	-5.571*	0.909	**<.001**	-7.892	-3.251
	12MESOS-18MESOS	-2.714*	1.017	**.038**	-5.310	-0.119
	8MESOS-18MESOS	-8.286*	0.998	**<.001**	-10.834	-5.737
RJAP	8MESOS-12MESOS	-7.355	7.299	.968	-25.985	11.276
	12MESOS-18MESOS	-14.986*	5.111	**.020**	-28.031	-1.941
	8MESOS-18MESOS	-22.341*	4.477	**<.001**	-33.768	-10.913
RJAD	8MESOS-12MESOS	-54.611*	6.149	**<.001**	-70.306	-38.915
	12MESOS-18MESOS	-16.818*	5.264	**.011**	-30.254	-3.381
	8MESOS-18MESOS	-71.429*	4.762	**<.001**	-83.583	-59.274

Es basa en mitjanes marginals estimades

* La diferència de mitjanes és significativa al nivell .05

b. Ajust per diverses comparacions: Bonferroni

Les diferències entre els moments d'avaluació per a la variable IJAL no són estadísticament significatives. En el cas de la variable IJAH i la variable RJAD, les diferències entre moments són estadísticament significatives per als tres moments. Pel que fa a la variable RJAP, les diferències entre moments són estadísticament significatives entre els 12 i els 18 mesos, i entre els 8 i els 18 mesos.

7. 2. 2. Curs evolutiu de la conducta de demanda.

Tal i com s'ha fet a l'apartat anterior, s'exposarà primerament de manera descriptiva la informació relativa a les distintes variables de conducta de demanda en cada moment d'avaluació en una sèrie de

taules i gràfiques, i després es presentaran els resultats de les MANOVA. Els estadístics descriptius per les variables de conducta de demanda es troben a la taula 19.

Table 19. Descriptive statistics of behavioural request variables for the longitudinal analysis

Estadístics descriptius

	Mitjana	Desv. Típica	N
IBRL8	7.68	3.79	28
IBRL12	10.39	4.48	28
IBRL18	5.11	3.72	28
IBRH8	0.00	0.00	28
IBRH12	6.04	4.66	28
IBRH18	11.36	7.54	28
RBRT8	0.00	0.00	28
RBRT12	47.62	33.57	28
RBRT18	71.37	27.88	28

L'evolució de les variables d'inici de conducta de demanda (IBR) es troba representada a la figura 18, mentre que l'evolució de la variable referent a la de resposta a la demanda (RBRT) es troba representada a la figura 17.

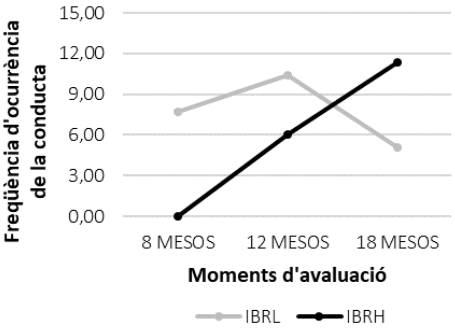

Figure 18. Growth pattern of IBR variables.

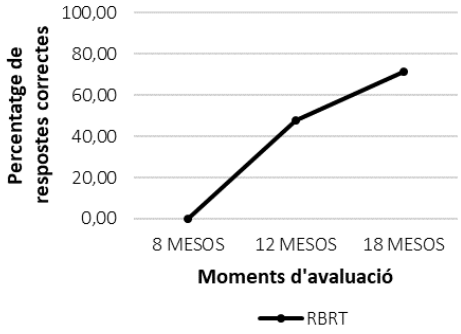

Figure 17. Growth pattern of RBRT.

Abans de la realització de les MANOVA, s'ha comprovat l'esfericitat de les variables. Per a això s'ha realitzat la prova de Mauchly (taula 20).

Table 20. Sphericity test of behavioural request variables for the longitudinal analysis

Prova d'esfericitat de Mauchly[a]

					Épsilon[b]		
	W de Mauchly	Aprox. Chi-quadrat	gl	Sig.	Greenhouse-Geisser	Huynh-Feldt	Límit inferior
IBRL	.956	1.172	2	**.556**	.958	1.000	0.500
IBRH	.608	12.934	2	.002	.718	.748	0.500
RBRT	.763	7.021	2	.030	.809	.853	0.500

a. Disseny: Intersecció

b. Es pot utilitzar per ajustar els graus de llibertat per a les proves mitjana de significació

Els resultats de les MANOVA amb les variables de conducta de demanda han revelat diferències estadísticament significatives entre els moments d'avaluació [Wilk's Lambda (λ) = .077; $F(3,25) = 100.463$; $p = < .001$; $\eta^2 p = .923$]. Les diferències foren significatives per a totes les variables de conducta de demanda: IBRL, IBRH i RBRIT (taula 21).

Table 21. Repeated measures MANOVA with behavioural request variables

Proves univariades

		Tipus IV de suma de quadrats	gl	Mitjana quadràtica	F	Sig.	Eta parcial al quadrat	Paràmetre sense centralitat	Potència observada[a]
IBRL	Esfericitat assumida	391.238	2	195.619	13.611	**<.001**	.335	27.222	.997
IBRH	Greenhouse-Geisser	1808.167	1.437	1258.423	34.744	**<.001**	.563	49.921	1.000
RBRT	Greenhouse-Geisser	73964.100	1.617	45734.376	59.878	**<.001**	.689	96.838	1.000

a. S'ha calculat utilitzant alpha = .05

A continuació, s'hi inclouen els resultats de les comparacions per parells entre els moments d'avaluació per a cada variable de conducta de demanda (taula 22).

Table 22. Pairwise MANOVA comparisons with behavioural request variables - Bonferroni adjust

Comparacions per parells						
		Diferència de mitjanes (I-J)	Desv. Error	Sig.[b]	95% d'interval de confiança per a diferència[b]	
					Límit inferior	Límit superior
IBRL	8MESOS-12MESOS	-2.714*	1.045	**.045**	-5.382	-0.047
	12MESOS-18MESOS	5.286*	1.082	**<.001**	2.523	8.048
	8MESOS-18MESOS	2.571*	0.903	**.025**	0.266	4.877
IBRH	8MESOS-12MESOS	-6.036*	0.881	**<.001**	-8.285	-3.787
	12MESOS-18MESOS	-5.321*	1.664	**.011**	-9.570	-1.073
	8MESOS-18MESOS	-11.357*	1.425	**<.001**	-14.994	-7.721
RBRT	8MESOS-12MESOS	-47.623*	6.344	**<.001**	-63.816	-31.429
	12MESOS-18MESOS	-23.743*	8.021	**.019**	-44.215	-3.270
	8MESOS-18MESOS	-71.366*	5.269	**<.001**	-84.816	-57.916

Es basa en mitjanes marginals estimades

* La diferència de mitjanes és significativa al nivell .05

b. Ajust per diverses comparacions: Bonferroni

Les diferències entre els tres moments d'avaluació són estadísticament significatives per a tots els casos.

7. 2. 3. Curs evolutiu de les habilitats d'interacció social.

Seguint l'esquema que s'ha seguit als anteriors apartats, primer s'exposaran els resultats de les variables a nivell descriptiu i després es presentaran els resultats de les MANOVA. Els estadístics descriptius per les variables d'interacció social es troben a la taula 23.

Table 23. Descriptive statistics of social interaction variables for the longitudinal analysis

Estadístics descriptius			
	Mitjana	Desv. Típica	N
ISI8	0.75	2.548	28
ISI12	2.89	2.671	28
ISI18	2.89	2.587	28
RSIT8	4.75	1.898	28
RSIT12	8.43	2.471	28
RSIT18	8.57	2.937	28

L'evolució de la variable d'inici de la interacció social (ISI) es troba representada a la figura 19, i l'evolució de la variable referent a la resposta d'interacció social (RIST) la trobem a la figura 20.

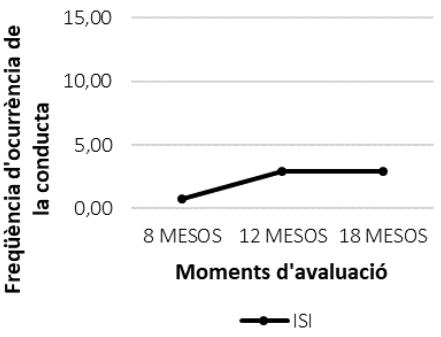

Figure 19. Growth pattern of ISI.

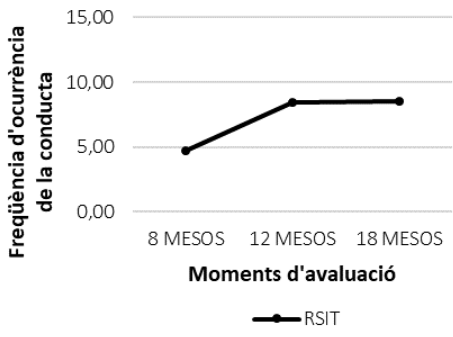

Figure 20. Growth pattern of RSIT.

Abans de la realització de les MANOVA, s'ha comprovat l'esfericitat de les variables. Per a això s'ha realitzat la prova de Mauchly (taula 24).

Table 24. Sphericity test of social interaction variables for the longitudinal analysis

Prova d'esfericitat de Mauchly[a]

					Épsilon[b]		
	W de Mauchly	Aprox. Chi-quadrat	gl	Sig.	Greenhouse-Geisser	Huynh-Feldt	Límit inferior
ISI	.806	5.612	2	**.060**	.837	.886	0.500
RSIT	.904	2.619	2	**.270**	.913	.975	0.500

a. Disseny: Intersecció

b. Es pot utilitzar per ajustar els graus de llibertat per a les proves mitjana de significació.

Els resultats de les MANOVA amb les variables d'interacció social han revelat diferències estadísticament significatives [Wilk's Lambda (λ) = .053; $F(2,26) = 231.505$; $p = < .001$; $\eta^2p = .947$]. Com podem veure a la taula 25, les diferències foren significatives per a totes les variables d'interacció social: ISI i RSIT.

Table 25. Repeated measures MANOVA with social interaction variables

Proves univariades

		Tipus IV de suma de quadrats	gl	Mitjana quadràtica	F	Sig.	Eta parcial al quadrat	Paràmetre sense centralitat	Potència observada[a]
ISI	Esfericitat assumida	85.714	2	42.857	6.307	**.003**	.189	6.307	.678
RSIT	Esfericitat assumida	262.786	2	131.393	30.251	**<.001**	.528	55.210	1.000

a. S'ha calculat utilitzant alpha = .05

A continuació, s'hi inclouen els resultats de les comparacions per parells entre els distints moments d'avaluació per a cada variable d'interacció social (taula 26).

Table 26. Pairwise MANOVA comparisons with social interaction variables - Bonferroni adjust

Comparacions per parells

		Diferència de mitjanes (I-J)	Desv. Error	Sig.[b]	95% d'interval de confiança per a diferència[b]	
					Límit inferior	Límit superior
ISI	8MESOS-12MESOS	-2.143*	0.764	**.028**	-4.093	-0.192
	12MESOS-18MESOS	0.000	0.775	1.000	-1.978	1.978
	8MESOS-18MESOS	-2.143*	0.521	**.001**	-3.473	-0.812
RSIT	8MESOS-12MESOS	-3.679*	0.499	**<.001**	-4.952	-2.405
	12MESOS-18MESOS	-0.143	0.526	1.000	-1.486	1.201
	8MESOS-18MESOS	-3.821*	0.636	**<.001**	-5.446	-2.197

* La diferència de mitjanes és significativa al nivell .05

b. Ajust per diverses comparacions: Bonferroni

Les diferències entre moments són estadísticament significatives entre els 8 i els 12 mesos, i entre els 8 i els 18 mesos, tant per a la variable ISI com per a la variable RSIT. Les diferències entre els 12 i els 18 mesos no són estadísticament significatives en cap cas.

7. 3. Anàlisi predictiva de les habilitats de comunicació social primerenca als 8 mesos sobre els primers signes de TEA als 12 mesos.

Aquest apartat estaria vinculat al tercer objectiu del present treball, que pretén analitzar la relació entre les habilitats de comunicació social primerenca i els primers marcadors de TEA als 12 mesos.

Per a això, s'han realitzat anàlisis de regressió lineal múltiple entre les variables de comunicació social primerenca als 8 mesos i la puntuació a l'instrument d'informe parental de marcadors primerencs de TEA als 12 mesos, el *First Year Inventory* (FYI) (Baranek et al., 2003). Aquestes anàlisis s'han fet amb 44 subjectes, que són els subjectes dels quals es tenen resultats en les variables escollides per a les anàlisis en els dos moments (als 8 i als 12 mesos). Els estadístics descriptius en aquest cas es troben a la taula 27.

Table 27. Descriptive statistics of the ESC variables at 8 months for the predictive analysis on ASD early symptomatology at 12 months

Estadístics descriptius

	Mitjana	Desv. Típica	N
RISK12	9.34	6.75	44
IJAL8	14.59	8.91	44
IJAH8	0.23	0.77	44
RJAP8	75.86	24.42	44
RJAD8	12.84	18.85	44
IBRL8	8.23	4.21	44
IBRH8	0.09	0.60	44
RBRT8	0.68	4.52	44
ISI8	0.91	2.55	44
RSIT8	4.98	1.92	44

Per a l'anàlisi de regressió múltiple, s'han considerat quatre models: (1) model amb variables d'inici d'atenció conjunta, (2) model amb variables de resposta d'atenció conjunta, (3) model amb variables de conducta de demanda, i (4) model amb variables d'interacció social. Per al model 3 s'ha eliminat la variable IBRH8 perquè és una variable amb poca variabilitat, és a dir, la gran majoria de les seues puntuacions

són zero. Aquesta variable fa referència a una conducta d'alt nivell que no se sol observar als 8 mesos.

Així mateix, s'ha incorporat en tots els models la variable sexe (SEX) com a variable control, vist que s'hi troben diferències significatives entre xiquets i xiquetes en la variable RISK12 (*t* de Student = 2.526; *p* = .015). Els xiquets puntuaren més alt que les xiquetes en aquesta variable. A continuació, s'hi presenten els resultats de l'anàlisi de regressió múltiple entre les variables de comunicació social primerenca als 8 mesos i la variable RISK12 (taula 28).

Table 28. Analysis of multiple regression with the ESC variables at 8 months on the prediction of ASD early signs at 12 months

Resum dels models

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de l'estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	(Constant), IJAL8, IJAH8, SEX	.344[a]	.118	.052	6.571468	.118	1.786	3	40	.165
2	(Constant), RJAP8, RJAD8, SEX	.401[a]	.160	.097	6.411821	.160	2.548	3	40	.069
3	(Constant), IBRL8, RBRT8, SEX	.417[a]	.174	.112	6.361588	.174	2.800	3	40	.052
4	(Constant), ISI8, RSIT8, SEX	.400[a]	.160	.097	6.413561	.160	2.539	3	40	.070

a. Variable dependent: RISK12

Cap dels models presenta significació estadística. És a dir, les variables de comunicació social primerenca als 8 mesos no prediuen la

presència de primers marcadors de TEA al primer any de vida en aquesta mostra de xiquets.

7. 4. Anàlisi predictiva de les habilitats de comunicació social primerenca als 8 i als 12 mesos sobre els primers marcadors de TEA als 18 mesos.

Aquesta secció està vinculada a l'objectiu quatre del present treball. S'ha utilitat el M-CHAT (Robins et al., 2001) per a l'avaluació de primers indicadors de TEA als 18 mesos. Aquest és un instrument que determina l'absència o la presència del risc. Per tant, la variable RISK18 és una variable dicotòmica. Per aquesta raó, s'ha realitzat una anàlisi de regressió logística. Les anàlisis s'han fet amb els subjectes dels quals es tenen resultats en tots tres moments (als 8, als 12 i als 18 mesos) per a les variables que s'han emprat. El nombre total de subjectes que han participat en aquestes anàlisis ha sigut de 29, dels quals 11 eren xiquets i 18 eren xiquetes. D'aquests 29 xiquets, 4 han obtingut resultats que indiquen risc de TEA (taula 29).

Table 29. High-risk and low-risk infants of the sample at 18 months old

Estadístics descriptius		
	Freqüència	Percentatge
Baix risc	25	86.21%
Alt risc	4	13.79%
Total	29	

D'aquests 4 xiquets, 3 són barons i 1 és una xiqueta. Front a aquesta desigualtat en quant al sexe dels xiquets amb risc, on hi ha més

xiquets que xiquetes, s'ha incorporat la variable sexe (SEX) als models d'anàlisi de regressió logística. Amb tot, la ràtio de gènere del TEA en l'actualitat a España és d'un 4/1, amb un nombre superior de xiquets que reben el diagnòstic en comparació amb el nombre de xiquetes que són diagnosticades (Morales Hidalgo, 2018). Per tant, la proporció de xiquets i de xiquetes del grup de risc, en aquest cas, es correspon amb les xifres de proporció de xiquets i xiquetes en població real.

L'exposició de resultats dintre d'aquesta secció s'organitzarà en dos grans blocs: (1) les habilitats de comunicació social primerenca als 8 mesos i els primers marcadors de TEA als 18 mesos, i (2) les habilitats de comunicació social primerenca als 12 mesos i els primers marcadors de TEA als 18 mesos.

7. 4. 1. Les habilitats de comunicació social primerenca als 8 mesos i els primers marcadors de TEA als 18 mesos.

En aquest apartat s'exposen les anàlisis que s'han realitzat per a explorar la relació predictiva entre les habilitats del comunicació social primerenca als 8 mesos i la presència de primers marcadors de TEA als 18 mesos. Així com s'ha fet amb les anàlisis de regressió d'anteriors apartats, s'han creat quatre models d'anàlisi de regressió logística: (1) model amb variables d'inici d'atenció conjunta, (2) model amb variables

de resposta d'atenció conjunta, (3) model amb variables de conducta de demanda, i (4) model amb variables d'interacció social.

De la mateixa manera, tal i com s'ha fet en les anteriors anàlisis amb variables dels 8 mesos, s'han eliminat les variables IBRH8 i RBRT8 perquè es vinculen a conductes de major complexitat que encara no es donen als 8 mesos. Són variables amb poca variabilitat, on les puntuacions són zero en la seua majoria.

Els resultats de les anàlisis de regressió logística entre les variables d'habilitats del comunicació social primerenca als 8 mesos i la variable RISK18 es troben a la taula 30.

Table 30. Analysis of logistic regression with the ESC variables at 8 months on the prediction of ASD early signs at 18 months

Resum dels models

Model	Predictors	Logaritme de la versemblança -2	R quadrat de Cox i Snell	R quadrat de Nagelkerke	Proves òmnibus de coeficients de model		
					Chi-quadrat	gl	Sig. Model
1	IJAL8, IJAH8, SEX, (Constant)	10.939[a]	.346	.628	12.330	3	**.006**
2	RJAP8, RJAD8, SEX, (Constant)	19.250[a]	.129	.235	4.019	3	.259
3	IBRL8, SEX, (Constant)	18.963[a]	.138	.250	4.306	2	.116
4	ISI8, RSIT8, SEX, (Constant)	14.985[a]	.248	.450	8.284	3	**.040**

Variable dependent: RISK18

a. L'estimació ha acabat en el nombre de iteració 20 perquè s'ha assolit el màxim d'iteracions. La solució final no es pot trobar

Els models 1 i 4 són estadísticament significatius. La seua *R* quadrat de Nagelkerke és de .628 i de .450, respectivament. És a dir, les conductes dels 8 mesos que millor prediuen la simptomatologia precoç de TEA als 18 mesos són les conductes d'inici d'atenció conjunta i les conductes d'interacció social.

Després de l'anàlisi dels models, s'han realitzat una sèrie d'anàlisis posteriors amb aquells models que han resultat significatius per conèixer millor les característiques específiques dels mateixos. Els resultats del model 1 estan a la taula 31.

Table 31. Logistic regression model 1 of the ESC variables at 8 months on the prediction of ASD early signs at 18 months

Variables en l'equació

		B	Error estàndard	Wald	gl	Sig.	Exp(B)
Pas 1[a]	IJAL8	-0.402	0.279	2.077	1	.150	0.669
	IJAH8	-16.638	12460.534	0.000	1	.999	0.000
	SEX	2.231	1.539	2.102	1	.147	9.308
	(Constant)	0.348	1.814	0.037	1	.848	1.416

a. Variable dependent: RISK18

Cap variable del model 1 té una significació estadística suficient que permeta saber quina variable en concret té el major poder predictiu. Possiblement, el que resulta significatiu és el model en conjunt.

D'altra banda, com es pot observar en la taula de classificació del model 1 (taula 32), el model té uns valors marcadament adients, amb una especificitat del 96% i una sensibilitat del 75%.

Table 32. Specificity and sensitivity levels of the logistic regression model 1 with the ESC variables at 8 months on the prediction of ASD early signs 18 months

Taula de classificació[a] (Model 1)

	Pronosticat		
Observat	Baix risc	Alt risc	Percentatge correcte
Baix risc	24	1	96
Alt risc	1	3	75
		Percentatge global	93.1

a. El valor de tall és .500
Variables independents: IJAL8, IJAH8, SEX, (Constant)

Pel que fa al model 2, els resultats que especifiquen la significació per a cada variable de l'equació es troben a la taula 33.

Table 33. Logistic regression model 2 of the ESC variables at 8 months on the prediction of ASD early signs at 18 months

Variables en l'equació

		B	Error estàndard	Wald	gl	Sig.	Exp(B)
Pas 1[a]	ISI8	-11.938	4982.711	0.000	1	.998	0.000
	RSIT8	-0.806	0.415	3.778	1	.052	0.447
	SEX	2.788	1.724	2.615	1	.106	16.253
	(Constant)	-0.142	1.420	0.010	1	.920	0.867

a. Variable dependent: RISK18

De la mateixa manera, cap variable del model 4 té una significació estadística suficient que permeta saber quina variable en concret té el major poder predictiu. De nou, possiblement, el que resulta significatiu és el model en conjunt.

Quant a la taula de classificació d'aquest model 4 (taula 34), aquesta ens indica que el model té uns valors, aquesta vegada, més modestos, amb una especificitat del 96% i una sensibilitat del 25%. El model 4 té una bona especificitat per a poder predir quins subjectes seran assignats al grup de baix risc, però pot ser no és tan bo a l'hora de predir els casos amb risc.

Table 34. Specificity and sensitivity levels of the logistic regression model 4 with the ESC variables at 8 months on the prediction of ASD early signs 18 months

Taula de classificació[a] (Model 4)

	Pronosticat		
Observat	Baix risc	Alt risc	Percentatge correcte
Baix risc	24	1	96
Alt risc	3	1	25
		Percentatge global	86.2

a. El valor de tall és .500
Variables independents: ISI8, RSIT8, SEX, (Constant)

En resum, i d'acord amb els resultats, les variables d'habilitats de comunicació social primerenca dels 8 mesos que millor prediuen el risc de TEA als 18 mesos són les variables d'inici d'atenció conjunta (model 1) i les variables d'interacció social (model 2). Cap variable en concret té un major pes a l'hora de predir el risc i el que resulta significatiu són els models en conjunt. Els millors resultats s'obtenen amb el model 1, tant a nivell d'especificitat com de sensibilitat.

7. 4. 2. Les habilitats de comunicació social primerenca als 12 mesos i els marcadors de TEA als 18 mesos.

Igual que a l'apartat anterior, s'han considerat quatre models d'anàlisi de regressió logística: (1) model amb variables d'inici d'atenció conjunta, (2) model amb variables de resposta d'atenció conjunta, (3) model amb variables de conducta de demanda, i (4) model amb variables d'interacció social. De la mateixa manera, s'ha incorporat per a cada model la variable SEX. Els resultats es troben a la taula 35.

Table 35. Analysis of logistic regression with the ESC variables at 12 months on the prediction of ASD early signs at 18 months

Resum dels models

Model	Predictors	Logaritme de la versemblança -2	R quadrat de Cox i Snell	R quadrat de Nagelkerke	Proves òmnibus de coeficients de model		
					Chi-quadrat	gl	Sig. Model
1	IJAL12, IJAH12, SEX, (Constant)	20.482[a]	.092	.166	2.787	3	.426
2	RJAP12, RJAD12, SEX, (Constant)	6.704[a]	.435	.789	16.565	3	**.001**
3	IBRL12, IBRH12, RBRT12, SEX, (Constant)	14.337[a]	.265	.480	8.932	4	.063
4	ISI12, RSIT12, SEX, (Constant)	18.986[a]	.137	.249	4.283	3	.232

Variable dependent: RISK18

a. L'estimació ha acabat en el nombre de iteració 20 perquè s'ha assolit el màxim d'iteracions. La solució final no es pot trobar

Solament el model 2 és estadísticament significatiu, amb una *R* quadrat de Nagelkerke de .789. És a dir, les conductes dels 12 mesos que millor prediuen la presència de primera simptomatologia TEA als 18 mesos són les conductes de resposta d'atenció conjunta.

S'han realitzat amb el model 2 anàlisis posteriors per conèixer millor les característiques específiques del mateix. Els resultats es troben a la taula 36.

Table 36. Logistic regression model 2 of the ESC variables at 12 months on the prediction of ASD early signs at 18 months

Variables en l'equació

		B	Error estàndard	Wald	gl	Sig.	Exp(B)
Pas 1[a]	SEX	5.268	5.301	0.988	1	.320	194.040
	RJAP12	-0.153	0.088	3.041	1	.081	0.858
	RJAD12	0.065	0.082	0.631	1	.427	1.067
	(Constant)	-0.673	5.089	0.018	1	.895	0.510

a. Variable dependent: RISK18

Igual com ocorre amb els models dels 8 mesos, cap variable d'aquest model té una significació estadística suficient. Igualment, podria ser que el que resulta significatiu és el model en conjunt.

Quant a la taula de classificació d'aquest model 2 amb variables dels 12 mesos (taula 37), veiem que els valors són altament adequats. Aquestos valors són similars als valors del model 1 dels 8 mesos, amb una especificitat del 96% i una sensibilitat del 75%.

Table 37. Specificity and sensitivity levels of the logistic regression model 2 with the ESC variables at 12 months on the prediction of ASD early signs 18 months

Taula de classificació[a] (Model 2)

	Pronosticat		
Observat	Baix risc	Alt risc	Percentatge correcte
Baix risc	24	1	96
Alt risc	1	3	75
		Percentatge global	93,1

a. El valor de tall és .500
Variables independents: RJAP12, RJAD12, SEX, (Constant)

En resum, la capacitat predictiva de les habilitats del comunicació social primerenca als 8 i als 12 mesos sobre la presència de signes de TEA als 18 mesos s'ha demostrat per a les variables d'inici d'atenció i d'interacció social als 8 mesos, i per a les variables de RJA als 12 mesos. Especialment, i d'acord amb els resultats, les conductes que als 8 mesos millor prediuen la presència de primers marcadors de TEA als 18 mesos són les conductes d'IJA; i les conductes que als 12 mesos millor prediuen la presència de primers marcadors de TEA als 18 mesos són les conductes de RJA.

7. 5. Anàlisi predictiva de les habilitats de comunicació social primerenca als 8 i als 12 mesos sobre les habilitats del llenguatge als 12 i als 18 mesos.

Aquesta secció està vinculada al cinquè i últim objectiu del present treball. Per a l'exposició del resultats dintre d'aquesta secció, la informació s'organitzarà en tres grans blocs: (1) les habilitats de comunicació social primerenca als 8 mesos i les habilitats del llenguatge als 12 mesos, (2) les habilitats de comunicació social primerenca als 12 mesos i les habilitats del llenguatge als 18 mesos, i (3) les habilitats de comunicació social primerenca als 8 mesos i les habilitats del llenguatge als 18 mesos.

A la vegada, dintre de cada apartat es realitzarà una anàlisi de regressió lineal múltiple per cadascuna de les habilitats del llenguatge avaluades i cada grup de variables d'habilitats de comunicació social primerenca incloses.

L'agrupació de variables per a la creació dels models, igual que en anteriors anàlisis, ha estat la següent: (1) variables d'inici d'atenció conjunta, (2) variables de resposta d'atenció conjunta, (3) variables de conducta de demanda, i (4) variables d'interacció social. A més a més, cadascun dels models inclou la variable sexe (SEX) com a variable de control en totes les anàlisis que s'han realitzat en els distints apartats.

7. 5. 1. Les habilitats de comunicació social primerenca als 8 mesos i les habilitats del llenguatge als 12 mesos.

Les anàlisis de regressió múltiple per a aquest apartat s'han fet amb els subjectes dels quals es tenen resultats en els dos moments (als 8 i als 12 mesos). El nombre total de subjectes que han participat en l'anàlisi ha estat de 44, dels quals 17 eren xiquets i 27 eren xiquetes.

L'ordre d'exposició dels resultats serà el següent: primer, es presentaran els resultats on la variable dependent és VOC12, seguidament, els resultats on la variable dependent és WC12, a continuació, els resultats on la variable dependent és WP12 i, per últim, els resultats on la variable dependent és GA12.

Table 38. Analysis of multiple regression with the ESC variables at 8 months on the prediction of vocalization behaviour at 12 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL8, IJAH8, SEX, (Constant)	.239[a]	.057	-.014	1.571	.057	0.807	3	40	.498
2	RJAP8, RJAD8, SEX, (Constant)	.236[a]	.056	-.015	1.572	.056	0.787	3	40	.508
3	IBRL8, RBRT8, SEX. (Constant)	.272[a]	.074	.005	1.556	.074	1.068	3	40	.374
4	ISI8, RSIT8, SEX, (Constant)	.233[a]	.054	-.017	1.573	.054	0.764	3	40	.521

a. Variable dependent: VOC12

Table 39. Analysis of multiple regression with the ESC variables at 8 months on the prediction of word comprehension at 12 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL8, IJAH8, SEX, (Constant)	.260[a]	.068	-.002	51.262	.068	0.969	3	40	.417
2	RJAP8, RJAD8, SEX, (Constant)	.440[a]	.193	.133	47.685	.193	3.196	3	40	**.034**
3	IBRL8, RBRT8, SEX, (Constant)	.271[a]	.073	.004	51.112	.073	1.053	3	40	.380
4	ISI8, RSIT8, SEX, (Constant)	.191[a]	.036	-.036	52.117	.036	0.504	3	40	.682

a. Variable dependent: WC12

Table 40. Analysis of multiple regression with the ESC variables at 8 months on the prediction of word production at 12 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL8, IJAH8, SEX, (Constant)	.172[a]	.030	-.043	12.318	.030	0.406	3	40	.750
2	RJAP8, RJAD8, SEX, (Constant)	.233[a]	.054	-.017	12.160	.054	0.765	3	40	.520
3	IBRL8, RBRT8, SEX, (Constant)	.284[a]	.081	.012	11.989	.081	1.170	3	40	.333
4	ISI8, RSIT8, SEX, (Constant)	.134[a]	.018	-.056	12.391	.018	0.244	3	40	.865

a. Variable dependent: WP12

Table 41. Analysis of multiple regression with the ESC variables at 8 months on the prediction of gestures and actions at 12 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL8, IJAH8, SEX, (Constant)	.406[a]	.165	.102	3.976	.165	2.628	3	40	.063
2	RJAP8, RJAD8, SEX, (Constant)	.453[a]	.205	.145	3.879	.205	3.439	3	40	**.026**
3	IBRL8, RBRT8, SEX, (Constant)	.463[a]	.214	.155	3.856	.214	3.634	3	40	**.021**
4	ISI8, RSIT8, SEX, (Constant)	.406[a]	.164	.102	3.976	.164	2.624	3	40	.064

a. Variable dependent: GA12

Els models que han resultat estadísticament significatius són: el model 2 (RJAP8, RJAD8, SEX), per a la predicció de la variable WC12 i de la variable GA12, i el model 3 (IBRL8, RBRT8, SEX) per a la predicció de la variable GA12.

S'han realitzat anàlisis posteriors amb els models que han resultat significatius, per conèixer millor les característiques específiques dels mateixos. Els resultats d'aquestes anàlisis s'inclouen a continuació.

L'anàlisi del model 2 (RJAP8, RJAD8, SEX) per a la predicció de la variable WC12 es troba a la taula 42.

Table 42. Linear regression model 2 of the ESC variables at 8 months on the prediction of word comprehension at 12 months

Coeficients[a]

Model		Coeficients no estandarditzats		Coeficients no estandarditzats	t	Sig.	95.0% interval de confiança per a B	
		B	Desv. Error	Beta			Límit inferior	Límit superior
2	(Constant)	41.202	30.160		1.366	.180	-19.753	102.158
	SEX	4.847	15.475	.047	0.313	.756	-26.428	36.123
	RJAP8	0.095	0.308	.045	0.308	.759	-0.528	0.718
	RJAD8	1.148	0.392	.423	2.930	**.006**	0.356	1.939

a. Variable dependent: WC12

L'anàlisi del model 2 (RJAP8, RJAD8, SEX) per a la predicció de la variable GA12 es troba a la taula 43.

Table 43. Linear regression model 2 of the ESC variables at 8 months on the prediction of gestures and actions at 12 months

Coeficients[a]

Model		Coeficients no estandarditzats		Coeficients no estandarditzats	t	Sig.	95.0% interval de confiança per a B	
		B	Desv. Error	Beta			Límit inferior	Límit superior
2	(Constant)	10.846	2.453		4.421	<.001	5.888	15.804
	SEX	3.020	1.259	.354	2.399	**.021**	0.476	5.564
	RJAP8	0.002	0.025	.009	0.062	.951	-0.049	0.052
	RJAD8	0.050	0.032	.224	1.565	.125	-0.015	0.114

a. Variable dependent: GA12

L'anàlisi del model 3 (IBRL8, RBRT8, SEX) per a la predicció de la variable GA12 es troba a la taula 44.

Table 44. Linear regression model 3 of the ESC variables at 8 months on the prediction of gestures and actions at 12 months

Coeficients[a]

Model		Coeficients no estandarditzats		Coeficients no estandarditzats	t	Sig.	95.0% interval de confiança per a B	
		B	Desv. Error	Beta			Límit inferior	Límit superior
3	(Constant)	9.763	2.147		4.547	<.001	5.423	14.102
	SEX	2.839	1.246	.333	2.278	**.028**	0.320	5.358
	IBRL8	0.252	0.148	.248	1.707	.096	-0.046	0.551
	RBRT8	-0.015	0.131	-.016	-0.116	.908	-0.280	0.250

a. Variable dependent: GA12

La variable de RJAD als 8 mesos ha resultat estadísticament significativa a l'hora de predir el volum de comprensió de paraules als 12 mesos, i la variable SEX és estadísticament significativa per a la predicció de la variable dependent GA12.

7. 5. 2. Les habilitats de comunicació social primerenca als 12 mesos i les habilitats del llenguatge als 18 mesos.

Pel que fa als resultats de l'anàlisi de regressió lineal múltiple realitzat per a explorar la relació entre les variables d'habilitats de la comunicació social primerenca als 12 mesos i les variables d'habilitats del llenguatge als 18 mesos, aquestes anàlisis s'han fet amb els subjectes dels quals es tenen resultats en els dos moments (als 12 i als

18 mesos). El nombre total de subjectes que han participat en l'anàlisi ha estat de 28, dels quals 10 eren xiquets i 18 eren xiquetes.

L'ordre d'exposició serà el següent: primer, es presentaran els resultats on la variable dependent és VOC18, seguidament, es presentaran els resultats on la variable dependent és WP18, a continuació, els resultats on la variable dependent és WEND18 i, per últim, els resultats on la variable dependent és MSYC18.

Table 45. Analysis of multiple regression with the ESC variables at 12 months on the prediction of vocalization behaviour at 18 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL12, IJAH12, SEX, (Constant)	.376[a]	.141	.034	2.614	.141	1.315	3	24	.293
2	RJAP12, RJAD12, SEX, (Constant)	.703[a]	.495	.431	2.005	.495	7.831	3	24	**.001**
3	IBRL12, IBRH12, RBRT12, SEX, (Constant)	.398[a]	.158	.012	2.643	.158	1.082	4	23	.388
4	ISI12, RSIT12, SEX, (Constant)	.356[a]	.127	.018	2.636	.127	1.164	3	24	.344

a. Variable dependent: VOC18

Table 46. Analysis of multiple regression with the ESC variables at 12 months on the prediction of word production at 18 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL12, IJAH12, SEX, (Constant)	.148[a]	.022	-.100	100.734	.022	0.180	3	24	.909
2	RJAP12, RJAD12, SEX, (Constant)	.480[a]	.230	.134	89.357	.230	2.396	3	24	.093
3	IBRL12, IBRH12, RBRT12, SEX, (Constant)	.272[a]	.074	-.087	100.121	.074	0.460	4	23	.764
4	ISI12, RSIT12, SEX, (Constant)	.274[a]	.075	-.041	97.973	.075	0.648	3	24	.592

a. Variable dependent: WP18

Table 47. Analysis of multiple regression with the ESC variables at 12 months on the prediction of word ending at 18 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL12, IJAH12, SEX, (Constant)	.147[a]	.022	-.101	2.395	.022	0.178	3	24	.910
2	RJAP12, RJAD12, SEX, (Constant)	.476[a]	.226	.130	2.130	.226	2.340	3	24	.099
3	IBRL12, IBRH12, RBRT12, SEX, (Constant)	.260[a]	.067	-.095	2.388	.067	0.416	4	23	.795
4	ISI12, RSIT12, SEX, (Constant)	.417[a]	.174	.071	2.201	.174	1.683	3	24	.197

a. Variable dependent: WEND18

Table 48. Analysis of multiple regression with the ESC variables at 12 months on the prediction of morphosyntactic complexity at 18 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL12, IJAH12, SEX, (Constant)	.326[a]	.106	-.005	10.744	.106	0.953	3	24	.431
2	RJAP12, RJAD12, SEX, (Constant)	.488[a]	.238	.143	9.921	.238	2.501	3	24	.084
3	IBRL12, IBRH12, RBRT12, SEX, (Constant)	.450[a]	.203	.064	10.366	.203	1.463	4	23	.246
4	ISI12, RSIT12, SEX, (Constant)	.463[a]	.214	.116	10.076	.214	2.179	3	24	.117

a. Variable dependent: MSYC18

De la mateixa manera que s'ha fet amb les variables dels 8 mesos, s'han realitzat anàlisis posteriors amb el model que ha resultat significatiu. En aquest cas és el model 2 (RJAP12, RJAD12, SEX), que prediu la variable VOC18. Els resultats d'aquesta anàlisi es troben a la taula 49.

Table 49. Linear regression model 2 of the ESC variables at 12 months on the prediction of vocalization behaviour at 18 months

Coeficients[a]

		Coeficients no estandarditzats		Coeficients no estandarditzats	t	Sig.	95.0% interval de confiança per a B	
Model		B	Desv. Error	Beta			Límit inferior	Límit superior
2	(Constant)	12.039	1.535		7.843	<.001	8.871	15.207
	SEX	-3.964	0.998	-.727	-3.973	**.001**	-6.024	-1.905
	RJAP12	0.018	0.015	.193	1.169	.254	-0.014	0.050
	RJAD12	0.069	0.020	.705	3.512	**.002**	0.029	0.110

a. Variable dependent: VOC18

La variable RJAD als 12 mesos és estadísticament significativa a l'hora de predir la competència lingüística referent a les vocalitzacions infantils als 18 mesos. Així mateix, la variable SEX és estadísticament significativa a l'hora de predir les vocalitzacions infantils als 18 mesos.

7. 5. 3. Les habilitats de comunicació social primerenca als 8 mesos i les habilitats del llenguatge als 18 mesos.

En últim lloc, s'inclouen els resultats de l'anàlisi de regressió lineal múltiple realitzat per a conèixer la relació entre les variables d'habilitats de la comunicació social primerenca als 8 mesos i les variables d'habilitats del llenguatge als 18 mesos.

Les anàlisis de regressió múltiple per a aquest apartat s'han fet amb els subjectes dels quals es tenen resultats en els dos moments (als 8 i als 18 mesos) per a les variables que s'han emprat per a l'anàlisi. El nombre total de subjectes que han participat en l'anàlisi ha estat de 28, dels quals 10 eren xiquets i 18 eren xiquetes.

L'ordre d'exposició dels resultats serà el mateix que a l'apartat anterior, vist que les variables independents són, en aquest cas, les mateixes.

Table 50. Analysis of multiple regression with the ESC variables at 8 months on the prediction of vocalization behaviour at 18 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL8, IJAH8, SEX, (Constant)	.343[a]	.118	.008	2.663	.118	1.068	3	24	.381
2	RJAP8, RJAD8, SEX, (Constant)	.364[a]	.133	.024	2.641	.133	1.224	3	24	.322
3	IBRL8, RBRT8, SEX, (Constant)	.268[a]	.072	-.002	2.676	.072	0.969	2	25	.393
4	ISI8, RSIT8, SEX, (Constant)	.264[a]	.070	-.046	2.735	.070	0.600	3	24	.621

a. Variable dependent: VOC18

Table 51. Analysis of multiple regression with the ESC variables at 8 months on the prediction of word production at 18 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL8, IJAH8, SEX, (Constant)	.428[a]	.183	.081	92.226	.183	1.793	3	24	.175
2	RJAP8, RJAD8, SEX, (Constant)	.392[a]	.153	.048	93.887	.153	1.450	3	24	.253
3	IBRL8, RBRT8, SEX, (Constant)	.054[a]	.003	-.077	99.831	.003	0.037	2	25	.964
4	ISI8, RSIT8, SEX, (Constant)	.293[a]	.086	-.029	97.571	.086	0.750	3	24	.533

a. Variable dependent: WP18

Table 52. Analysis of multiple regression with the ESC variables at 8 months on the prediction of word ending at 18 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL8, IJAH8, SEX, (Constant)	.410[a]	.168	.064	2.474	.168	1.619	3	24	.211
2	RJAP8, RJAD8, SEX, (Constant)	.361[a]	.130	.022	2.530	.130	1.200	3	24	.331
3	IBRL8, RBRT8, SEX, (Constant)	.142[a]	.020	-.058	2.632	.020	0.256	2	25	.776
4	ISI8, RSIT8, SEX, (Constant)	.379[a]	.144	.037	2.511	.144	1.342	3	24	.284

a. Variable dependent: WEND18

Table 53. Analysis of multiple regression with the ESC variables at 8 months on the prediction of morphosyntactic complexity at 18 months

Resum del model

						Estadístics de canvi				
Model	Predictors	R	R quadrat	R quadrat ajustat	Error estàndard de la estimació	Canvi en R quadrat	Canvi en F	gl1	gl2	Sig. Canvi en F
1	IJAL8, IJAH8, SEX, (Constant)	.417[a]	.174	.070	10.356	.174	1.682	3	24	.197
2	RJAP8, RJAD8, SEX, (Constant)	.402[a]	.161	.057	10.433	.161	1.540	3	24	.230
3	IBRL8, RBRT8, SEX, (Constant)	.285[a]	.081	.008	10.700	.081	1.104	2	25	.347
4	ISI8, RSIT8, SEX, (Constant)	.462[a]	.213	.115	10.107	.213	2.165	3	24	.118

a. Variable dependent: MSYC18

En aquest cas, cap dels models de predicció de les variables d'habilitats de comunicació social primerenca als 8 mesos sobre la competència lingüística als 18 mesos arriba al nivell de significació estadística.

En síntesi, després de l'anàlisi dels resultats de les proves realitzades, destaca que la conducta primerenca que més està vinculada a la competència lingüística als 18 mesos és la resposta d'atenció conjunta distal (RJAD), tant als 8 com als 12 mesos.

CHAPTER 8: Discussion

The objective of this research was to know more about those specific early communication abilities that constitute pivotal aspects in later infant language development, and how the evaluation of these skills can be of a crucial matter when identifying early markers of ASD. Joint attention, behavioural request and social interaction were measured in three moments (8, 12, and 18 months of age), and then related to language skills and early ASD symptomatology, in a research design of a longitudinal nature.

Four main questions have articulated this research: (1) How do early social communication abilities relate to each other? (2) How do early social communication abilities evolve through 8, 12 and 18 months of age? (3) Can deficiencies in these abilities constitute early signs of ASD? (4) How do these skills relate to subsequent language skills?

8. 1. How do early social communication abilities relate to each other?

The first aim of this study was to explore how the measurements of the early social communication abilities relate to each other. Bivariate correlations with all the early social

communication variables were conducted for each assessment moment.

The first remarkable result in this regard is that the initial hypothesis was not met. The initial expected results were that the different variables of early social communication would not correlate significantly. Some studies have previously pointed out the lack of significant correlation between, for example, IJA and RJA (Salo et al., 2018; Thorup et al., 2018; Vaughan Van Hecke et al., 2007), or have found out how IJAL and IJAH are not necessarily related (Pickard & Ingersoll, 2015). However, a number of significant associations and some noteworthy trends could be observable in our results: (1) some variables of initiating behaviour were related to the responding behaviour variable from the same dimension; (2) some lower-level variables were related to their higher-level analogue; finally, (3) some variables belonging to different dimensions, but on the same level of complexity, were related.

At 8 and 18 months old, IJAL was significantly related to RJAP. This is a case of a variable of initiating joint attention related to its responding equivalent. These two variables are both lower-level variables of joint attention. Thus, they refer to the same behaviour (gaze alternation). IJAL is linked to the use of gaze alternation to initiate an episode of joint attention, whereas RJAP is linked to the use of this same strategy as a response of an invitation to participate in an episode of joint attention. In the same line, ISI showed to be related to RSIT at

8 months old. These associations might be suggesting that probably having greater willingness of initiating episodes of social communication may be accompanied by being more open to participate in these same types of episodes when invited.

On the other hand, at 8 months old, IJAL showed to be significantly related to its higher-level analogue (IJAH). A possible explanation for this association could be the following. Gaze alternation (IJAL) is a communicative behaviour which is observable around 8-9 months old (Beuker et al., 2013; Thorup et al., 2018). IJAH is a behaviour of a higher-level nature which tends to emerge after 10 months of age (Beuker et al., 2013), and it is generally observable in children around the first birthday (Matthews et al., 2012; Mundy, 2016; Mundy et al., 2007). However, some of the children of our sample did show IJAH in the first visit. In fact, we found that that those children who were displaying gestural joint attention at the first visit were also using eye alternation more frequently to display joint attention. According to Mundy, Sullivan and Mastergeorge (2009), differences in social sharing can be attributed to neural maturation.

At 12 months, this same significant association (IJAL - IJAH) was negative. One possible explanation for this inverse correlation is that, at 12 months of age, children generally begin to learn how to use gestures to communicate (e. g. point, show) (Matthews et al., 2012; Mundy, 2016; Mundy et al., 2007). Therefore, infants start to use gestures to participate in joint attention and they often decrease the

use of eye contact to do so (Pickard & Ingersoll, 2015). New more complex strategies seem to be replacing the more basic old ones. Another possible explanation for this inverse correlation may lie on the way these behaviours were coded. According to the manual of the instrument used to assess early social communication (ESCS; Mundy et al., 2003), IJAH can occur with eye contact or without eye contact. In a coding session, when a 12-month-old child uses gestures to exhibit joint attention, this is scored as IJAH. If this episode of IJAH occurs with eye contact, it would be still scored as IJAH because a gesture is being used, regardless of the use of a lower-level joint attention behaviour (eye contact). This is why some of the eye contact and gaze alternation behaviours may have been computed as IJAH and not as IJAL. That may have made IJAL scores decreases as IJAH scores increased.

We also see the association of a lower-level variable and their higher-level analogue with the significant correlation between RJAP and RJAD observed at 12 and at 18 months of age. These are two behaviours that refer to the same episode: responding to joint attention. RJAP occurs when the child attends an object that is within his range, while RJAD occurs when he attends an object that is in the distance. Children usually use RJAP at an early age and they only begin to show higher-level RJA behaviours (RJAD) after the first birthday. RJAD emerges later in development, since distal objects require higher skills to be identified (Salo et al., 2018). This would explain why this

association between RJAP and RJAD was not significant at an early age, at 8 months old, but it was at 12 and at 18 months old.

Finally, IJAL and IBRL showed to be related at 8 months old. These two variables of a lower-level nature had a significant relation, even belonging to different categories regarding the type of communication. IJAL and IBRL refer to the same behaviours (eye contact and gaze alternation) used for different purposes (declarative and imperative communication, respectively). These are resources that can be used broadly and sometimes with different objectives. Taken from this prism, it can be expectable that those children who tend to use their gaze to initiate joint attention more frequently, will rely more on the same strategy to initiate episodes of behavioural request. This same type of significant association was observed with higher-level variables at 12 months old (IJAH – IBRH). At 8 months, a significant correlation was observed with lower-level behaviours because this is the usual strategy most used at such early ages (Beuker et al., 2013; Thorup et al., 2018). On the other hand, this same type of association can be expected to occur with higher-level behaviours at 12 months of age, since children begin to use gestures for triadic communication after the first year of life (Matthews et al., 2012; Mundy, 2016; Mundy et al., 2007).

Overall, the results showed some trends which were observable through the three evaluation moments. IJAL and RJAP were the variables with the highest number of significant correlations across the

different moments. This seems to be aligned with some results in future sections. The dimensions of initiating and responding to joint attention appeared frequently as predictors of the other aspects evaluated for the present study: early signs of ASD and language skills.

8. 2. The growth pattern of the different early social communication abilities.

This second section is aimed to cover the discussion regarding the evolution of the different variables across the three assessment moments: when the children were 8, 12 and 18 months old.

8. 2. 1. The growth pattern of joint attention.

One of the things that first stands out from the results regarding the growth pattern of joint attention is that IJAL's evolution was flat and its mean scores remained high through the three moments. This would be indicating that lower-level joint attention is a behaviour that emerges early in development. Previous research have offered evidence over the idea that gaze alternation is a communicative behaviour that is observable at 8-9 months old (Beuker et al., 2013; Thorup et al., 2018). Moreover, this is a communicative behaviour that stabilizes relatively soon. The scores for IJAL did not show any significant differences between any of the three moments. No

substantial shift was observable in any case: 8-12 months, 12-18 months and 8-18 months.

In addition to that, IJAL evolution was also noteworthy because a slight decrease was observable between 12 and 18 months old. Although this decrease was not statistically significant, it should be mentioned due to its peculiarity. This fact can probably be better understood if analysed together with the growth pattern of IJAH. Previous research have shown how IJAL growth pattern decreases from 12 to 18 months, whilst IJAH growth pattern increases in the same period (Beuker et al., 2013). This could be reflecting the fact that infants, after having learnt the lower-level behaviour of eye contact and gaze alternation, begin to acquire new strategies, and they start to use gestures to communicate triadically. Therefore, simpler past strategies decrease their frequency (Pickard & Ingersoll, 2015). Based on previous research, it appears that IJA measures habitually show a decline around 15 months, and then a rebound around 18 months (Ibáñez et al., 2013; Mundy et al., 2007; Sheinkopf et al., 2004).

RJAP also showed a remarkable evolutionary pattern in the present study. At 8 months old, RJAP mean scores were relatively high. From 8 to 12 months old, they slightly increased, yet the difference between them was not significant. This could be reflecting the fact that this is a behaviour with an early onset (Salo et al., 2018). Nevertheless, a significant increase of RJAP mean scores was observable between 12 and 18 months. This result could indicate that, in our case, there is a

substantial change in the value of RJAP during this developmental period. According to these results, we suggest that infants exhibit this behaviour of proximal joint attention from early ages, and they begin to demonstrate management of this resource around 18 months old (Morales et al., 2000). These results were consistent with previous research. According to Salo et al. (2018), infants are able to adequately respond to joint attention when objects are close (RJAP) around 9-10 months old, and start to respond appropriately to distant objects (RJAD) around 14-15 months of age.

Lastly, the higher-level joint attention variables, IJAH and RJAD, presented a generally increasing pattern. They showed a very low mean score at 8 months old, and a noteworthy upward pattern between 8 and 12 months old. This could be indicating that these are behaviours that do not emerge until the first birthday. Since these are higher-level joint attention behaviours, it is expectable that they do not show at 8 months old, and they only begin to surface at 12 months old (Matthews et al., 2012; Mundy, 2016; Mundy et al., 2007). Finally, these variables showed a second relatively substantial increase from 12 to 18 months, maybe reflecting the mastering of these higher-level behaviours (Morales et al., 2000; Vaughan Van Hecke et al., 2012).

8. 2. 2. The growth pattern of behavioural request.

The results regarding the growth pattern of behavioural request seem to behave similarly to the results of joint attention. IBRL exhibited a high initial starting mean score, whilst the higher-level behaviours (IBRH and RBRT) showed a typically escalating pattern. They started from a low mean score at 8 months and went progressively increasing through 12 and 18 months old. Lower-level variables of behavioural request showed a higher starting point because they refer to behaviours that infants display at early ages. Contrary, the average scores of the higher-level variables were zero (or close to zero) at 8 months of age, and increased abruptly at 12 months. That would be indicating that these variables refer to behaviours that tend to emerge after the first birthday (Matthews et al., 2012; Mundy, 2016; Mundy et al., 2007).

In addition to that, the variable of IBRL exhibited an evolution pattern which seemed evocative of the evolution pattern of IJAL. The growth pattern of this two lower-level triadic communication was considerably alike. They showed an initial ascent from 8 to 12 months old, and a slight decline from 12 to 18 months old. The differences between 12 and 18 months old were not significant for IJAL, but they were for IBRL. This milestone may be better understood if analysed together with the growth pattern of its analogues, IBRH and IJAH. It could also be, in this case, that the use of higher-level behavioural

request would be substituting the simpler strategies (Pickard & Ingersoll, 2015). The higher-level variables in this section (IBRH and RBRT) displayed a similar pattern of the higher-level variables of joint attention (IJAH and RJAD). They presented a generally increasing pattern, with a zero-mean score at 8 months old and an upward pattern from 8 to 12 months and from 12 to 18 months. Based on previous literature, since these are higher-level behaviours, we could expect that they did not show at 8 months old and they only began to surface at 12 months (Matthews et al., 2012; Mundy, 2016; Mundy et al., 2007). Finally, the mean scores for these variables displayed a second increase from 12 to 18 months, possibly reflecting the mastering of these higher-level requesting skills (Morales et al., 2000; Mundy, 2016).

8. 2. 3. The growth pattern of social interaction.

Lastly, the growth pattern of the two variables of social interaction (ISI and RSIT) showed a peculiar shape. Both variables had a low starting point at 8 months old, they presented a notable increase from 8 to 12 months old, and they stabilized from 12 to 18 months old. The differences between 12 and 18 months were not significant in any of the two variables.

This pattern of a first robust surge from 8 to 12 months and a marked stabilisation from 12 to 18 months could be explained if we

consider the following idea. Social interaction variables were measured with a reduced number of tasks, and that made the score range to be more limited. The *Early Social Communication Scales* (ESCS) (Mundy et al., 2003) were used to asses ISI, among the other ESC variables. The task that this instrument indicates to assess ISI is the initiation of a turn-taking game with a ball and with a car. The general responses that can be observed when this task is performed by the examiner are either (1) the infant initiates the game with the ball, (2) the infant initiates the game with the car, (3) the infant initiates the game with both, or (4) the infant does not initiate the game in any of the two trials. Thereby, the score range that can be attained in this case is 0-2. Additionally, ISI can have extra score when the child initiates what is called a "prohibited act". An example of a "prohibited act" would be the child throwing the ball on the floor and expecting the examiner to pick it up. And then doing it again in a type of turn-taking game of the infant throwing the ball on the floor and the examiner picking it up. This "prohibited act" occurred in few occasions with a small number of subjects. As for RSIT, this variable is assessed with two tasks, where scores can be obtained if (1) the child responds to an invitation to participate in a turn-taking game, and (2) the child responds with eye contact and positive affect to being tackled. In both cases, these are tasks with a limited-range score.

Everything considered, social interaction variables exhibited a peculiar pattern if compared to joint attention and behavioural request

variables. This could be expected since this is a behaviour which somewhat detaches from the other two groups of behaviours. Social interaction, as it has been considered in this study, is a dyadic-type interaction behaviour, whereas joint attention and behavioural request are of a triadic nature (infant – examiner – object). Furthermore, they are measured differently with the ESCS (Mundy et al., 2003), and that may have made the scores in these three dimensions result unalike.

8. 3. Early social communication skills in predicting early signs of ASD.

One of the core objectives of this study was to analyse if early social communication skills can be reliable early predictors for the risk of ASD symptomatology. Our results pointed out that joint attention measures can be significant predictors of early ASD symptoms. The initial hypothesis was that 8-months ESC impairments would not significantly predict ASD symptoms, while 12-months ESC impairments would. However, our results indicated that IJA impairments at 8 months are a significant predictor of ASD symptomatology at 18 months. Moreover, RJA impairments at 12 months also showed to be a significant predictor of ASD symptom at 18 months. Lastly, ISI deficiencies at 8 months showed to be a significant predictor of ASD early signs at 18 months. No significant relation was found between any ESC measurements at 8 months old and ASD early symptomatology at 12 months old.

Our results are aligned with the results of Sullivan et al. (2007). They suggested that RJA impairments can be reliable indicators of early ASD symptomatology at 14 months old in an infant population of at-risk children. Our results are also broadly consistent with previous research that has underlined the importance of IJA measurements to establish early ASD symptomatology (Dawson et al., 2004; Franchini et al., 2019; Ibáñez et al., 2013; Landa et al., 2007; Macari et al., 2012; Schertz & Odom, 2007; Schertz et al., 2018; Thorup et al., 2018).

On the other hand, our results appear lined up with the idea that early ASD signs can be observed at 8 months old in some cases (Ibáñez et al., 2013; Landa et al., 2007; Macari et al., 2012; Mundy, 2016; Veness et al., 2014). However, it must be noted that some authors claim that the evolution of IJA is also important. Although early measures of IJA are important to consider the presence of ASD early signs, it is more important to observe the way IJA evolves. It is its evolution what really helps identify those who will receive the diagnosis (Ibáñez et al., 2013; Macari et al., 2012). Authors such as Gangi et al. (2014) and Landa et al. (2013) recommend proceeding carefully when considering IJA measures as an indisputable indicator of ASD early signs, especially at very early ages. Some children later diagnosed with ASD do not show any sign at 10–12 months of age (Werner et al., 2005). It has been suggested that most of the infants at risk show early ASD symptomatology around 12-14 months of age (Jones et al., 2014; Mundy, 2016; Zwaigenbaum et al., 2013), and these signs are

completely obvious only after 18 months old (Baron-Cohen et al., 1996; Charman et al., 1997; Franchini et al., 2019; Johnson, 2008). A design with further assessment moments, included in the continuation of this study, will hopefully explore this issue in greater depth.

Despite all this, our results may still be promising as, indeed, ESC abilities at 8 months did show to be significant to predict early ASD signs at 18 months of age. Both IJA and RJA were associated to ASD early markers at 18 months old. IJA and RJA have been related to ASD early symptomatology in past research. However, it has been reported that disturbances in IJA are a better predictor of early ASD symptomatology than deficiencies in RJA (Charman, 2003; Dawson et al., 2004; Gotham et al., 2007; Hobson & Hobson, 2007; Sigman et al., 1999). It seems that early RJA deficiencies may remit in older children with ASD, when language may have arisen. IJA impairments tend to be present through the preschool period and also through adolescence (Charman, 2003; Gillespie-Lynch et al., 2012; Mundy, 2016). Contrary to these mentioned investigations, we did find significant relations between both IJA and RJA, and early ASD signs. IJA impairments at 8 months were predictive of ASD early markers at 18 months, whilst RJA impairments at 12 months were predictive of ASD early signs at 18 months. These measures showed a markedly acceptable specificity (96%) when predicting ASD first markers at 18 months.

In addition to that, we must consider those studies that suggest that IJAH has been consistently proving to be a more solid and

dependable predictor of ASD early signs than IJAL (Chiang et al., 2008; Franchini et al., 2019; Pickard & Ingersoll, 2015). This idea was included in our initial research hypothesis. However, our results highlighted the importance of both measures, IJAH and IJAL, since the regression model that included both variables was the significant model that predicted early ASD symptoms. Maybe these results were obtained because IJA variables were significant in predicting early markers if measured at 8 months old, when higher-level behaviours are not generally observable. It is possible that the authors who defend the importance of IJAH have observed IJAH's predictivity in later ages. Higher-level nature behaviours may begin to be observable after 10 months of age (Beuker et al., 2013).

Finally, our results are in line with the postulate that declarative communication (joint attention) is frequently more impaired in children with autism than imperative communication (behavioural request) (Baron-Cohen, 1992; Camaioni et al., 2003; Tomasello & Camaioni, 1997). IJA and RJA variables were significant predictors of ASD early signs, while no behavioural request variable showed significance in predicting first ASD markers. Our initial hypothesis was that joint attention variables would significantly predict ASD early makers based on the fact that impairments in joint attention is a characteristic feature of individuals with autism (Franchini et al., 2019; Schertz & Odom, 2007; Schertz et al., 2018). This hypothesis was met.

8. 4. Early social communication skills and subsequent language skills

Our final objective was to explore the relations between ESC skills and subsequent language skills, to determine if these early communication abilities may constitute good predictors of later linguistic competence. Our initial hypothesis was that ESC measures would not significantly predict linguistic competence before 12 months of age. However, our results suggested that RJA measures at 8 months old can significantly predict the volume of receptive vocabulary at 12 months. Moreover, RJA measures at 12 months old can significantly predict linguistic competence related to pre-speech vocalizations at 18 months. The one measure that held the highest significant predictive value was RJAD, in both cases at 8 and at 12 months of age.

These findings are in line with previous research which has underlined the fact that children with better joint attention skills tend to perform better in language tasks (Beuker et al., 2013; Brooks & Meltzoff, 2005, 2008; Colonnesi et al., 2010; Jones et al., 2009; Salo et al., 2018). Specifically, RJA measurements have shown to be significantly related to language acquisition in previous research (Morales et al., 2000; Mundy & Newell, 2007; Salo et al., 2018; Wu et al., 2013).

Particularly, RJA has been more often linked to later language development than IJA in early ages (Adamson et al., 2019; Mundy, Kasari, Sigman, & Ruskin, 1995; Salo et al., 2018). It is believed that RJA

facilitates vocabulary acquisition, as it allows children to identify the object being referenced by the adult (Seager et al., 2018). On the other hand, it seems that joint attention skills are not related to expressive language in low-risk children (Adamson et al., 2019). Considering that responding successfully to joint attention would mean that the infant can understand the intentions of others, it is expectable that RJA could be connected to receptive language (Salo et al., 2018). In our study, RJA was predictive of receptive vocabulary but not to expressive vocabulary. In that sense, our findings confirmed the lack of significant association between joint attention and expressive language in low-risk samples.

Literature is inconclusive regarding the associations between IJA and later language skills. Findings are sometimes disparate. Some studies suggest that the ability to initiate joint attention at 10 months can significantly predict later expressive language at 16 and 23 months (Camaioni, Castelli, Longobardi, & Volterra, 1991; Mason-Apps, Stojanovik, Houston-Price, & Buckley, 2008). Vuksanovic and Jovana (2013) defend the role of IJA in predicting linguistic competence claiming that an active participation in early communication is required for it to act as a precursor to later language development. These authors have pointed out how IJAH correlates positively with both concurrent and subsequent receptive and expressive language (Vuksanovic & Jovana, 2013). Especially in infants who have little expressive language, good IJAH skills are a compact foundation of later

language skills (Vuksanovic & Jovana, 2013). Charman et al. (2000) have also reported significant associations between IJAL and language. However, our results point in another direction. No significant relationship was found between IJA measures and expressive language. Some authors have even revealed a negative correlation between IJAL and expressive language (Salo et al., 2018). They argue that those 12-month-old infants who are still relying on eye contact and gaze alternation to initiate joint attention, a strategy more typical of younger children, could be showing some delay in communicative development (Salo et al., 2018).

Our initial research hypothesis was that IJA variables would relate to aspects of productive language, and RJA variables would relate to word comprehension (Luyster & Lord, 2010; Maljaars et al., 2012; Salo et al., 2018; Thurm et al., 2007). Our results pointed out significant predictive relationships between RJA and word comprehension, but no significant associations between IJA and productive language. A possible explanation for why RJA was a significant predictor of language outcomes and IJA was not is the fact that the measurements were conducted when the children were very young. Children generally do not yet initiate joint attention at very early ages. Very young infants display RJA in a higher frequency than they do IJA (Seager et al., 2018). This is also a possible explanation to why findings are sometimes inconclusive regarding the association between IJA and later language skills. If these abilities are measured too early in development they may

not be very informative. Including further assessment moments in the design of a longitudinal study would hopefully contribute to clarify this issue.

Another explanation for this lower predictive power of IJA on language outcomes comes from the idea that IJA seems to be more crucial in specific episodes of first vocabulary acquisition and not so much for continued language development (Bottema-Beutel, 2016; Herlihy, Knoch, Vibert, & Fein, 2013; Toth et al., 2006). According to some research, IJA is primarily associated with current language, whilst RJA correlates significantly with both present and subsequent language development (Adamson et al., 2019). Our findings also add to the plausibility of this proposal, since RJA measures were predictive of subsequent language skills. Specifically, RJAD at 8 was predictive of word comprehension, and RJAD at 12 months old was predictive of pre-speech vocalizations.

Regarding language performance in terms of early syntax, our results suggested that ESC measures do not predict linguistic outcomes such as grammar (word ending) and production of first sentences (morphosyntactic complexity) at 12 and 18 months old. However, variables of higher-level of joint attention have been related in previous investigations with two-word sentences (Özçalişkan & Goldin-Meadow, 2005), and with syntactic complexity at 3 years old (Rowe & Goldin-Meadow, 2009). Probably in our case, the syntactic measures were

evaluated too early in child development to find a significant predictive relationship between ESC and syntactic complexity.

Finally, it seems that joint attention (declarative communication) is the type of triadic communication which is more strongly related to linguistic competence (Colonnesi et al., 2010; Salo et al., 2019; Southgate et al., 2007). Contrary, triadic communication used with imperative purposes (behavioural request) has not been so frequently reported to be predictive of language outcomes (Colonnesi et al., 2010; Lüke et al., 2017; Mundy et al., 2007; Smith, 2003). Our results provided some support for this hypothesis, which was also our initial research hypothesis. RJA measures were significant to predict language abilities, and no behavioural request variables showed significant predictivity in this regard.

CONCLUSIONS, LIMITATIONS AND PROSPECTIVE

As conclusions, we highlight that lower-level communicative behaviours, of both joint attention and behavioural request, have an early onset, and they can be observed at 8 months. Some examples of these lower-level behaviours are alternating gaze or having eye contact. On the other hand, higher-level behaviours have a later appearance, and they are observable after the first year of life. These are gestural communicative behaviours such as pointing, giving or showing. Previous research has also revealed the early onset of lower-level communicative behaviours (Beuker et al., 2013; Salo et al., 2018; Thorup et al., 2018), and the later emergence of higher-level communicative behaviours (Matthews et al., 2012; Mundy, 2016; Mundy et al., 2007).

If we compare the initiating behaviours with the response ones, the main conclusion of our research is that responding behaviours generally appear earlier in development. Initiating behaviours are of a greater complexity, that is the reason why they begin to be observable after 12 months of age. As noted by other research too, response behaviours are evolutionarily simpler behaviours, compared to initiating behaviours (Beuker et al., 2013; Salo et al., 2018; Thorup et al., 2018; Vaughan Van Hecke et al., 2007).

Social interaction behaviours have a peculiar growth pattern, compared with the growth pattern of triadic communication (joint attention and behavioural request). The growth pattern of social interaction indicates that these are behaviours that are acquired around 12 months of age. Once they are acquired, they tend to be maintained. These social interaction behaviours refer to social dyadic episodes like turn-taking games or tickling.

With regards to the predictive power of early social communication, the main conclusion is that difficulties in joint attention at an early age are good indicators of ASD early symptoms at 18 months. Other authors have also pointed out this idea (Franchini et al., 2019; Schertz & Odom, 2007; Schertz et al., 2018). Difficulties in initiating joint attention at 8 months old can predict the presence of ASD early markers at 18 months, as other research have also revealed (Ibáñez et al., 2013). While at 12 months, difficulties to adequately respond to an invitation to joint attention constitute an indicator of the symptomatology (Yoder et al., 2009). Likewise, our conclusions are that responding to joint attention is related to some subsequent aspects of language, such as word comprehension and vocalizations. Especially responding to distal joint attention at 8 months is associated with the volume of receptive vocabulary at 12 months. Moreover, this same behaviour at 12 months is significantly related to vocalization behaviour at 18 months. Previous research has also pointed out the associations between responding to joint attention and language acquisition, and

especially receptive language (Morales et al., 2000; Mundy & Newell, 2007; Salo et al., 2018; Wu et al., 2013).

This research aims to serve as an initial step in the exploration of the role of early social communication in subsequent linguistic developmental and ASD early detection. We hope that these findings can make some contributions to the identification of ASD first signs at an early age, but we would like to acknowledge some aspects that should be considered when interpreting them.

Firstly, this is a study with a relatively small sample and with a very specific geographical location. All participants were from the province of València, which limits the possibility of generalizing the results to other populations: other countries or other cultures. In addition to that, most of the participating families in the study were from a medium-high socioeconomic status. Hence, it would remain to explore how the same behaviours analysed in this research manifest in different social and economic contexts. However, the difficulty of having samples of these characteristics (very young children) and the high cost of longitudinal research designs should be considered. Longitudinal studies require a great investment of time, and results only begin to be observed in the medium or long term. In addition to that, we must consider the sample cost. Maintaining the fidelity of the participants is a big challenge in these cases. Future studies could aim to replicate the results of this research in a larger sample.

In reference to data collection in this investigation, the challenge resided in the fact that the questionnaires administered to assess linguistic competence were complemented by parents. This inevitably implied a certain level of subjectivity, which may have led to a certain underestimation or overestimation of the infant's linguistic performance (Iverson et al., 2017; Zwaigenbaum et al., 2013). Nonetheless, these parent report instruments are designed to minimize the risk of subjectivity by using clear and precise questions. Results are obtained by requesting parents to recognize from a list, and not to do an open recall. If parents are openly asked about their own child's performance, it tends to result in a higher false memory rate, and that can mask the results. To solve this, the MICD uses checklists.

On the other hand, the use of parental reports offered a great advantage to the data. It probably allowed our data to have a suitable ecological validity. Parents have multiple opportunities to observe their child in different interactive contexts and that makes parent reports more representative of the real child communicative performance than laboratory measures. Experimental settings are very unlikely to create the scenario where all the linguistic repertoire of the infant can be displayed (Bonifacio et al., 2007; Salerni, Assanelli, D'Odorico, & Rossi, 2007). Currently, parent-reports are still the most reliable method to measure different aspects of early development when infants are very young (Farrant, Maybery, & Fletcher, 2011).

As for the suggestions for future research, associations between early social communication and language development accentuate over time with age (Colonnesi et al., 2010). Thereby, further assessment moments designed to continue this study will hopefully be able to shed some light on this hypothesis.

Further exploration of the metabolic and neurodevelopmental factors involved in early social communication would also be important for future study. Differences in social communication skills in early infancy may not always be visible from general behavioural observation, and measuring the frequency of occurrence of a behaviour cannot always be enough to capture these phenomena. Physiological measures of children's responsiveness to social stimuli might be very enlightening. The set of early ASD signs could be further studied through the incorporation of potential biomarkers, which may come from neuroelectrophysiology (Elsabbagh et al., 2012) and genetic research (Scherer & Dawson, 2011). Numerous authors have highlighted the necessity of broaden the understanding of valid biometrics (Dawson et al., 2012; Vaughan Van Hecke et al., 2013; Voos et al., 2013). Research that includes more detailed techniques, such as eye-tracking measures, could be extremely informative (Caruana et al., 2018; Falck-Ytter, Carlström, & Johansson, 2015; Zwaigenbaum et al., 2013). Moreover, these methods can be used with infants as young as 6-month-old, allowing for the possibility of an even earlier detection.

All in all, we acknowledge the limitations of parent's report and the fact that the sample may have been small and geographically restrained. Nonetheless, the time consuming and expensive nature of long-term longitudinal researches must be taken into consideration. These studies provide an invaluable starting point for investigating developmental milestones, which often are constantly evolving. This is the case of language acquisition and first ASD signs. The evolving nature of these objects of study makes longitudinal studies appropriate.

In conclusion, and despite the limitations, these findings are valuable in light of a better understanding of early social communication skills and its relationship with subsequent linguistic competence. Furthermore, they can contribute to better comprehend the role of early social communication in ASD early detection. Even without confirmation of the diagnosis, early intervention is of special interest because it allows at-risk children to improve their social skills and, consequently, their quality of life (Dawson et al., 2010; Johnson, 2008; Kasari et al., 2010, 2012; Reichow & Wolery, 2009; Rogers & Dawson, 2010; Twyman et al., 2009; Zwaigenbaum et al., 2013).

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ANNEXES

ANNEX I. Aprovació del projecte pel Comitè d'Ètica de la Investigació amb Medicaments de l'Hospital Universitari i Politècnic la Fe.

La Fe
Departament de Salut

FPNT-CEIB-04 (B)

DICTAMEN DEL COMITÉ DE ÉTICA DE LA INVESTIGACIÓN CON MEDICAMENTOS

Don Serafín Rodríguez Capellán, Secretario del Comité de Ética de la Investigación con Medicamentos del Hospital Universitario y Politécnico La Fe,

CERTIFICA

Que este Comité ha evaluado en su sesión de fecha **9 de mayo de 2017**, el Proyecto de Investigación:

Título: **"LA PREMATURIDAD COMO FACTOR DE RIESGO DE ALTERACIONES EN LA INTERACCIÓN SOCIAL Y COMUNICACIÓN TEMPRANA: SINTOMATOLOGÍA RELACIONADA CON EL TRASTORNO DEL ESPECTRO AUTISTA."**
Nº de registro: **2017/0167**
Versión/fecha de la memoria del proyecto: **12 de abril de 2017**
Versión/fecha de la Hoja de Información al Paciente y Consentimiento Informado: **1/ 12 de abril de 2017**

Que dicho proyecto se ajusta a las normativas éticas sobre investigación biomédica con sujetos humanos y es viable en cuanto al planteamiento científico, objetivos, material y métodos, etc, descritos en la solicitud, así como la Hoja de Información al Paciente y el Consentimiento Informado.

En consecuencia, este Comité acuerda emitir **INFORME FAVORABLE** de dicho Proyecto de Investigación que será realizado en el Hospital Universitario y Politécnico La Fe por el/la **Dr. / Dra. MÁXIMO VENTO TORRES** del servicio/unidad/grupo de investigación de **NEONATOLOGÍA** como Investigador Principal.

Que el CEIm del Hospital Universitario y Politécnico La Fe, tanto en su composición como en sus procedimientos, cumple con las normas de BPC (CPMP/ICH/135/95) y con la legislación vigente que regula su funcionamiento, y que la composición del CEIm del Hospital Universitario y Politécnico La Fe es la indicada en el anexo I, teniendo en cuenta que, en el caso de que algún miembro participe en el estudio o declare algún conflicto de interés, no habrá participado en la evaluación ni en el dictamen de la solicitud de autorización del estudio clínico.

Lo que firmo en Valencia, a 9 de mayo de 2017

Fdo.: Don Serafín Rodríguez Capellán
Secretario del Comité de Ética de la Investigación con Medicamentos

La Fe
Departament de Salut

FPNT-CEIB-04 (B)

ANEXO I
COMPOSICIÓN CEIm

Presidente:
Dra. ADELA CAÑETE NIETO (Oncología Pediátrica)

Vicepresidente:
Dr. SALVADOR ALIÑO PELLICER (Catedrático Farmacólogo Clínico)

Secretario:
D. SERAFIN RODRIGUEZ CAPELLAN (Licenciado en derecho-Ajeno profesión sanitaria)

Miembros:
Dr. LUIS ALMENAR BONET (Cardiología)
Dra. ESTHER ZORIO GRIMA (Cardiología)
Dr. MARINO BLANES JULIA (Unidad de Enfermedades Infecciosas)
Dra. INMACULADA CALVO PENADES (Reumatología Pediátrica)
Dr. BONAVENTURA CASANOVA ESTRUCH (Neurología)
Dr. JOSE VICENTE CASTELL RIPOLL (Hepatología Experimental)
Dr. JOSE VICENTE CERVERA ZAMORA (Hematología)
Dra. MARIA JOSE GOMEZ-LECHON MOLINER (Investigadora del Grupo Acreditado en Hepatología Experimental)
Dra. MARIA ISABEL IZQUIERDO MACIAN (Neonatología)
Dr. JOSE LOPEZ ALDEGUER (Enfermedades Infecciosas)
Dr. LUIS MARTINEZ DOLZ (Cardiología)
Dr. JAVIER PEMAN GARCIA (Investigador del Grupo Acreditado multidisciplinar para el estudio de la Infección Grave)
Dr. ALFREDO PERALES MARIN (Ginecología y Obstetricia)
Dra. PAULA RAMIREZ GALLEYMORE (UCI)
Dr. JOAN SALOM SANVALERO (Unidad de Circulación Cerebral Experimental)
Dra. PILAR SAENZ GONZALEZ (Neonatología)
Dr. MAXIMO VENTO TORRES (Neonatología)
Dra. BEGOÑA POLO MIQUEL (Gastroenterología y Nutrición Pediátrica)
Dra. IRATXE ZARRAGOIKOETXEA JAUREGUI (Anestesia y Reanimación)
Dra. SARA BRUGGER FRIGOLS (Radiodiagnóstico)
Dra. EUGENIA PAREJA IBARS (Cirugía General y Aparato Digestivo)
Dr. JAIME SANZ CABALLER (Investigador del Grupo Acreditado en Hematología y Hemoterapia)
Dra. PILAR SEPULVEDA SANCHIS (Cardiocirculatorio)
Dr. FELIPE QUEROL FUENTES (Hemostasia y Trombosis)
Dra. ESPERANZA FERRER FERRANDIZ (Directora Escuela de Enfermería)
Dra. MARIA LUISA MARTINEZ TRIGUERO (Análisis Clínicos)
Dra. MARIA TORDERA BAVIERA (Farmacéutica del Hospital)
Dr. CESAR DIAZ GARCIA (Reproducción - Miembro de la Comisión de Investigación)
Dr. SANTIAGO DOMINGO DEL POZO (Oncología Ginecológica)
Dr. ENRIQUE VIOSCA HERRERO (Medicina Física y Rehabilitación)
Dr. JOAQUIN ERNESTO HINOJOSA DE VAL (Medicina Digestiva - Hospital de Manises)
Dr. RAFAEL BOTELLA ESTRADA (Dermatología)
Dra. Mª ANGELES CANOS VERDECHO (Unidad del Dolor)
Dña. ANA MARIA VIVAS BROSETA (Directora de Enfermería)
Dña. MARIA VICTORIA PARICIO GOMEZ (Enfermería)

La Fe
Departament de Salut

FPNT-CEIB-04 (B)

Dr. OSCAR JOSÉ JUAN VIDAL (Oncología Médica)
Dr. JOSÉ MARÍA CANELLES GAMIR (Farmacéutico de Atención Primaria)
Dr. JOSE IVORRA CORTES (Reumatología)
Dr. MATTEO FRASSON (Cirugía General y Aparato Digestivo)
Dr. JOSÉ VICENTE SOLANAS PRATS (Atención Primaria)
Dr. OSCAR DIAZ CAMBRONERO (Anestesia y Reanimación)
Dña. PILAR ROBLES VILLALBA (Vicepresidenta de la asociación de Miastenia - Miembro ajeno a la profesión sanitaria)
Dr. JAVIER LLUNA GONZÁLEZ (Cirugía Pediátrica - Miembro del Comité de Ética Asistencial)
Dra. MONICA ALMIÑANA RIQUE (Gerente del Dpto. de Salud Valencia La Fe)
D. MIGUEL ÁNGEL CANO TORRES (Secretario de ASLEUVAL - Representante de los pacientes)

La Fe
Departament de Salut

FPNT-CEIB-04 (B)

*OBSERVACIONES ADICIONALES AL DICTAMEN:

Se emite INFORME FAVORABLE, pero se solicita al Investigador Principal que, antes de comenzar el estudio, realice las siguientes correcciones en la HIP:

- Deben sustituir "Comité Ético de Investigación Biomédica", por "Comité de Ética de la Investigación Clínica con medicamentos".
- En el apartado de BENEFICIOS, deben indicarle al paciente que, su participación en el estudio, puede no aportarle ningún beneficio.
- En el apartado de CONFIDENCIALIDAD de la información del paciente, deben indicar que el responsable del Registro de los datos en la Agencia Española de Protección Datos, es la Institución.
- Deben suprimir la cláusula novena, ya que no hay obligación legal de comunicar a la Fiscalía la participación de menores en un proyecto de investigación.

ANNEX II. Consentiment Informat.

VNIVERSITAT DE VALÈNCIA Facultat de Psicologia

Departament Psicologia Bàsica

Unitat d'Investigació: Processos psicològics aplicats a les relacions humanes.

Projecte: La prematuritat com a factor de risc d'alteracions en la interacció social i la comunicació primerenca: simptomatologia relacionada amb el trastorn de l'espectre autista.

CONSENTIMENT INFORMAT

Jo, _____ pare, mare o representant legal de _____, amb DNI: _____ **he sigut informat/da** per la Dra. Ana D'Ocon Giménez, Professora Titular d'Universitat, Departament de Psicologia Bàsica de la Universitat de València, i declare que:

- He rebut suficient informació sobre el projecte.
- He pogut fer preguntes sobre el projecte.
- He rebut respostes satisfactòries a les meues preguntes.
- Estic informat que durant l'avaluació es realitzaran video-gravacions per a la correcta avaluació de les variables objecte d'estudi.
- Comprenc que la meua participació és voluntària i lliure de compensació.
- Comprenc que tota la informació relacionada amb mi i amb el meu/a fill/a serà tractat amb absoluta confidencialitat per part del personal encarregat de la investigació. Així mateix, si els resultats de l'estudi foren susceptibles de publicació en fòrums científics, en cap moment es proporcionaran dades personals dels participants que han col·laborat en aquesta investigació.
- Comprenc que tota la informació recollida pel projecte serà protegida com dicta la Llei de Protecció de Dades de Caràcter Personal (LO 15/1999).
- Comprenc que puc retirar-me de l'estudi quan vulga.
- Els resultats del projecte podran ser accessibles prèvia sol·licitud.

☐ **Done el meu consentiment** per a la utilització de les dades que s'obtinguen en les avaluacions programades amb el meu/a fill/a en el mencionat projecte d'investigació.

☐ **Done el meu consentiment** per a la utilització de les imatges en fòrums científics com seminaris de formació, congressos, etc.

Dades de contacte:

Adreça: _____

Telèfon: _____ Data: _____

Dra. Ana D'Ocon

Professora Titular de Psicologia
Departament de Psicologia Bàsica,
Universitat de València

Pare, Mare o Representant Legal

Av. Blasco Ibáñez, 21 46010 València-Espanya Telf. nº 96 386 44 53

VNIVERSITAT DE VALÈNCIA Facultat de Psicologia

Departament Psicologia Bàsica

Unidad de Investigación: Procesos psicológicos aplicados a las relaciones humanas.

Proyecto: La prematuridad como factor de riesgo de alteraciones en la interacción social i la comunicación temprana: sintomatología relacionada con el trastorno del espectro autista.

CONSENTIMIENTO INFORMADO

Yo, _____ padre, madre o representante legal de _____, con DNI: _____ **he sido informado/a** por la Dra. Ana D'Ocon Giménez, Profesora Titular de Universidad, Departamento de Psicología Básica de la Universitat de València, y declaro que:

- He recibido suficiente información sobre el proyecto.
- He podido hacer preguntas sobre el proyecto.
- He recibido respuestas satisfactorias a mis preguntas.
- Estoy informado de que durante la evaluación se realizarán video-grabaciones para la correcta evaluación de las variables objeto de estudio.
- Comprendo que mi participación es voluntaria y libre de compensación.
- Comprendo que toda la información relacionada conmigo y con mi hijo/a será tratada con absoluta confidencialidad por parte del personal encargado de la investigación. Asimismo, si los resultados del estudio fueran susceptibles de publicación en foros científicos, en ningún momento se proporcionarán datos personales de los participantes que han colaborado en esta investigación.
- Comprendo que toda la información recogida por el proyecto será protegida como dicta la Ley de Protección de Datos de Carácter Personal (LO 15/1999).
- Comprendo que puedo retirarme del estudio cuando quiera.
- Los resultados del proyecto podrán ser accesibles previa solicitud.

☐ **Doy mi consentimiento** para la utilización de los datos que se obtengan en las evaluaciones programadas con mi hijo/a en el mencionado proyecto de investigación.

☐ **Doy mi consentimiento** para la utilización de las imágenes en foros científicos como seminarios de formación, congresos, etc.

Datos de contacto:

Dirección: _____

Teléfono: _____ Fecha: _____

Dra. Ana D'Ocon

Profesora Titular de Psicología
Departamento de Psicología Básica,
Universitat de València

Padre, Madre o Representante Legal

Av. Blasco Ibáñez, 21 46010 València-Espanya Telf. nº 96 386 44 53

ANNEX III. Entrevista Inicial.

Dades personals

DATA: _____

DADES SOBRE EL/LA XIQUET/A		
NOM I COGNOMS:		
SEXE: □ Dona □ Home	DATA DE NAIXEMENT: EDAT GESTACIONAL: PES EN NÀIXER:	
Presenta algun trastorn en el neurodesenvolupament? (Especificar en cas afirmatiu)		
Nombre de germans: _____ Edats:	Escolarització, escola infantil/guarderia? □ Sí □ No	Edat d'Inici: _____ Hores al dia: _____
Algun dels germans presenta algun trastorn en el neurodesenvolupament? (Especificar en cas afirmatiu: Nombre, Edat i Trastorn/s).		

DADES SOBRE LA FAMÍLIA
ESTRUCTURA DE LA FAMÍLIA: □ Nuclear (dos progenitors i fills en la llar familiar) □ Extensa (iaios, tios o altres en la llar familiar) Qui?_____ □ Monoparental (Un sol progenitor i fills en la llar familiar) □ Reconstituïda (amb fills de relacions anteriors) □ Altra: _____
Nombre de fills que conviuen en la llar: _____
Algun dels germans presenta algun trastorn en el neurodesenvolupament? (Especificar en cas afirmatiu: Nombre, Edat i Trastorn/s).
ENTORN ON VIU: □ Urbà □ Zona residencial □ Rural □ Altres: _____
INGRESOS FAMILARS (anuals): □ Menys de 6.000 € □ 6.000 € - 11.999 € □ 12.000€ - 23.999 € □ 24.000 € - 35.999 € □ 36.000 € - 50.000 € □ Més de 50.000 €

Dades personals

DADES SOBRE VOSTÉ	
NOM I COGNOMS (progenitor 1):	
DATA DE NAIXEMENT:	ADREÇA:
SEXO: □ Dona □ Home	
TELÈFON:	E-MAIL:
ESTAT CIVIL: □ Casat/da □ Solter/a □ Viu en parella □ Separat/da o Divorciat/da □ Vidu/a	
ESTUDIS: □ Sense estudis □ Primaris/Bàsics □ Estudis Mitjans (Batxillerat, cicles mitjà i superiors) □ Estudis Superiors (Formació universitària)	OCUPACIÓ: □ No treballa □ Amo/a de casa □ Treballa a temps parcial □ Treballa a temps complet □ Pensionista/ Jubilat/da □ Altres: _____

DADES SOBRE L'ALTRE PROGENITOR	
NOM I COGNOMS (progenitor 2):	
DATA DE NAIXEMENT:	ADREÇA:
SEXO: □ Dona □ Home	
TELÈFON:	E-MAIL:
ESTAT CIVIL: □ Casat/da □ Solter/a □ Viu en parella □ Separat/da o Divorciat/da □ Vidu/a	
ESTUDIS: □ Sense estudis □ Primaris/Bàsics □ Estudis Mitjans (Batxillerat, cicles mitjà i superiors) □ Estudis Superiors (Formació universitària)	OCUPACIÓ: □ No treballa □ Amo/a de casa □ Treballa a temps parcial □ Treballa a temps complet □ Pensionista/ Jubilat/da □ Altres: _____

ALTRES DADES
Observacions:

FECHA: _____

DATOS SOBRE EL/LA NIÑO/A

NOMBRE Y APELLIDOS:

SEXO:
□ Mujer
□ Varón

FECHA DE NACIMIENTO:

EDAD GESTACIONAL:

PESO AL NACER:

¿Presenta algún trastorno en el neurodesarrollo? (Especificar en caso afirmativo)

Número de hermanos: _____

Edades:

Escolarización, ¿escuela infantil/guardería?
□ Sí
□ No

Edad de Inició: _____

Horas al día: _____

¿Alguno de los hermanos presenta algún trastorno en el neurodesarrollo? (Especificar en caso afirmativo: Número, Edad y Trastorno/s).

Idiomas que se hablan en casa (valenciano, castellano, inglés, italiano...)

DATOS SOBRE LA FAMILIA

ESTRUCTURA DE LA FAMILIA:

□ Nuclear (dos progenitores e hijo/s en el hogar)
□ Extensa (abuelos, tíos u otros en el hogar) ¿Quién? _____
□ Monoparental (Un solo progenitor e hijo/s en el hogar)
□ Reconstituida (con hijos de relaciones anteriores)
□ Otra: _____

Número de hijos que conviven en el hogar: _____

¿Algún familiar cercano o usted mismo/a presenta algún trastorno en el neurodesarrollo o de otro tipo? (Especificar en caso afirmativo: Número, Edad y Trastorno/s).

ENTORNO DONDE VIVE:
□ Urbano □ Zona residencial □ Rural □ Otros: _____

INGRESOS FAMILARES (anuales):
□ Menos de 6.000 €
□ 6.000 € - 11.999 €
□ 12.000€ - 23.999 €
□ 24.000 € - 35.999 €
□ 36.000 € - 50.000 €
□ Más de 50.000 €

Datos personales

DATOS SOBRE USTED

NOMBRE Y APELLIDOS (progenitor 1):

FECHA DE NACIMIENTO:

SEXO:
□ Mujer
□ Varón

DIRECCIÓN:

TELÉFONO:

E-MAIL:

ESTADO CIVIL:
□ Casado/a □ Soltero/a □ Vive en pareja □ Separado/a o Divorciado/a □ Viudo/a

ESTUDIOS:
□ Sin estudios
□ Primarios/Básicos
□ Estudios Medios (Bachillerato, ciclos medios y superiores)
□ Estudios Superiores (Formación universitaria)

OCUPACIÓN:
□ No trabaja
□ Amo/a de casa
□ Trabaja a tiempo parcial
□ Trabaja a tiempo completo
□ Pensionista/Jubilado/a
□ Otros: _____

DATOS SOBRE EL OTRO PROGENITOR

NOMBRE Y APELLIDOS (progenitor 2):

FECHA DE NACIMIENTO:

SEXO:
□ Mujer
□ Varón

DIRECCIÓN:

TELÉFONO:

E-MAIL:

ESTADO CIVIL:
□ Casado/a □ Soltero/a □ Vive en pareja □ Separado/a o Divorciado/a □ Viudo/a

ESTUDIOS:
□ Sin estudios
□ Primarios/Básicos
□ Estudios Medios (Bachillerato, ciclos medios y superiores)
□ Estudios Superiores (Formación universitaria)

OCUPACIÓN:
□ No trabaja
□ Amo/a de casa
□ Trabaja a tiempo parcial
□ Trabaja a tiempo completo
□ Pensionista/Jubilado/a
□ Otros: _____

OTROS DATOS

Observaciones:

ANNEX IV. Taula de Codificació.

CONDUCTA	NIVELL	CODI (nom que rep al Registre de Codificació)	TASCA	DESCRIPCIÓ
IJAL	Baix	EYE CONTACT	OBJECTE ESPECTACLE	El xiquet fa CO amb l'examinador mentre està *manipulant* o *tocant* un joguet inactiu. No es considera EYE CONTACT si el CO està elucidat per un moviment o un soroll que ha fet l'examinador.
IJAL	Baix	ALTERNATES (REFERENCES)	OBJECTE ESPECTACLE	El xiquet alterna la mirada entre un joguet actiu i l'examinador. Típicament quan l'objecte actiu està sobre la taula o en les mans de l'examinador, però també es comptabilitza si el xiquet mira a l'examinador quan el joguet s'activa en les seues mans.
IJAH	Alt	POINTS	OBJECTE ESPECTACLE, LLIBRE	*Abans que l'examinador assenyale*: El xiquet assenyala el joguet actiu o El xiquet assenyala les imatges del llibre o El xiquet assenyala els pòsters de la paret. Pot donar-se amb o sense contacte ocular.
IJAH	Alt	SHOW	OBJECTE ESPECTACLE	El xiquet aixeca un joguet davant de la cara de l'examinador. Típicament situacions breus en què el xiquet retira el joguet després de mostrar-lo. Pot resultar dificultós diferenciar aquesta conducta de la conducta de GIVE – si el xiquet es resisteix a donar el joguet quan l'examinador intenta agafar-li'l, aleshores es considera SHOW.
RJAL	Baix	FOLLOWING PROXIMAL POINT/TOUCH	LLIBRE	L'examinador assenyala **6 imatges**. Es comptabilitza cada vegada que el xiquet gira el cap i orienta la mirada en direcció a les imatges assenyalades.

RJAH	Alt	FOLLOWING LINE OF REGARD	POSTERS	*Per a esquerra i dreta*: es comptabilitza cada vegada que el xiquet gira el seu cap i orienta la mirada suficientment per assegurar que està mirant cap a la direcció correcta – **més enllà del dit de l'examinador**. *Per als pòsters de darrere*: es comptabilitza quan el xiquet gira el cap més de 90° per a assegurar-se que està mirant darrere. És necessària la girada clara del cap del xiquet en els casos en què el dit de l'examinador no siga visible.
IBRL	Baix	EYE CONTACT	OBJECTE ESPECTACLE	El xiquet fa CO amb l'examinador <u>després que el joguet s'ature</u> o El xiquet fa CO amb l'examinador quan aquest li agafa el joguet. No es considera EYE CONTACT si el CO està elucidat per un moviment o un soroll que ha fet l'examinador.
IBRL	Baix	REACH	OBJECTE ESPECTACLE	El xiquet estén els braços cap a un objecte **fora del seu abast**. No es considera REACH si el xiquet aconsegueix agafar el joguet. Si el xiquet s'incorpora del seient i intenta agafar el joguet, es considera REACH si intenta agafar *el joguet que està a l'abast de l'examinador*. Una conducta de REACH acaba quan el xiquet es retrau o deixa caure els braços estirats sobre la taula durant **més de 2 segons**. Interrupcions i re-iniciacions del gest de REACH amb menys de 2 segons d'interval es comptabilitzen com una sola conducta.
IBRL	Baix	APPEAL		El xiquet combina CO amb REACH.

			OBJECTE ESPECTACLE	El CO ha de ser *breu* i superposat a un període més prolongat de REACH. CO i REACH han de ser *simultanis* en algun moment durant l'episodi.
IBRH	Alt	GIVE	OBJECTE ESPECTACLE; POT DE PLÀSTIC	El xiquet empenta l'objecte cap a l'examinador o El xiquet aixeca l'objecte cap a l'examinador (típicament cap al seu cos o les seues mans) Pot ocórrer amb o sense CO.
IBRH	Alt	POINT	OBJECTE ESPECTACLE	El xiquet estén el seu dit índex per assenyalar el joguet inactiu desitjat. Si un POINT es torna REACH o viceversa, es comptabilitza només el nivell de conducta *més alt* (per exemple, POINT). Pot ocórrer amb o sense CO.
RBR	Cap	FOLLOW COMANDS	OBJECTE ESPECTACLE; POT DE PLÀSTIC	Resposta al "Dona-me'l" El xiquet dona el joguet sol·licitat, amb o sense gest acompanyant, o mostra comprensió dient no amb el cap o dient "no". Assegureu-se'n d'usar un to imperatiu (i no un to juganer).
ISI	Cap	INITIATES TURN-TAKING	TURN-TAKING	Després de rebre la pilota o el cotxet de joguet, *el xiquet retorna l'objecte a l'examinador.* Ha d'ocórrer abans que el xiquet haja vist com l'examinador espenta l'objecte.
ISI	Cap	TEASE		El xiquet realitza una *acció prohibida* mentre manté un afecte positiu cap a l'examinador. Per exemple, apartant l'objecte després que l'examinador diga "Dona-me'l" o llançant intencionadament l'objecte cap a l'altra banda de la sala. Solament es considera un TEASE si el xiquet manté l'episodi continuadament.

				Però si el xiquet llança l'objecte i després el recupera o n'obté **un altre**, aleshores es comptabilitza un nou TEASE.
ISI	Cap	INITIATES SONG/TICKLE	PESSIGOLLES /CANÇÓ	El xiquet fa CO amb l'examinador i recorre els dits sobre la taula o El xiquet fa el gest de fer pessigolles o El xiquet fa palmes o El xiquet canta. La conducta només pot ser comptabilitzada després d'haver presentat la primera TICKLE/SONG i haver ocorregut **al menys una tasca addicional.**
RSIL	Baix	EYE CONTACT	PESSIGOLLES	El xiquet fa CO amb l'examinador després que l'examinador faça pessigolles al xiquet i faça una pausa després de cada episodi.
RSIL	Baix	ACT	PESSIGOLLES	El xiquet fa vocalitzacions o colpeja la taula o El xiquet s'arrima a l'examinador després que l'examinador haja fet pessigolles al xiquet.
RSIL	Baix	APPEAL	PESSIGOLLES	El xiquet combina ACT amb CO.
RSIH	Alt	RESPONDS (MANTAINS) TURN-TAKING	TURN-TAKING	El xiquet retorna la pilota o el cotxet de joguet a l'examinador en el joc de torns. Es comptabilitza el nombre màxim de torns consecutius que el xiquet manté amb l'examinador.
RSIH	Alt	RESPONDS TO INVITATION	RESPOSTA A LA INVITACIÓ (BARRET, ULLERES, o PINTA)	Es comptabilitza cada objecte que és col·locat correctament en el cap de l'examinador front a la pregunta de "*Puc jugar?*" El xiquet pot rebre una puntuació de 0 a 3 punts en aquest apartat.

Recuperat i traduït de Mundy et al. (2003, p. 50-56)

ANNEX V. Registre de Codificació.

Early Social Communication Scales - Coding Sheet

Subject Number: _____ Date Administered: _____ Date Scored: _____ Tape Number: _____

Age: _____ Tester: _____ Rater: _____ Counter: _____

Mundy et al., 2003, University of Miami

Initiating Joint Attention

	1	5	10	15	20	*Sum*
Eye Contact (EC)	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐	___
Alternate	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐	___

Lower-Level Total: ☐☐

Point	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐ ___
Point & EC	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐ ___
Show	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐ ___

Higher-Level Total: ☐☐

IJA Total: ☐☐

Bid to Caregiver ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ ___

Responding to Joint Attention

	1	5	10	15	20
Follows Point	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐ ___

Line of Regard

	Left	Back Left	Right	Back Right
Trial 1	☐	☐	☐	☐
Delayed	☐	☐	☐	☐
Trial 2	☐	☐	☐	☐
Delayed	☐	☐	☐	☐

% Correct: ___

RJA Total: ☐☐

Point in Imitation ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ ___

Initiating Behavioral Requests

	1	5	10	15	20	*Sum*
Eye Contact (EC)	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐	___
Reach	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐	___
Appeal	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐	___

Lower-Level Total: ☐☐

Point	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐ ___
Point & EC	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐ ___
Give	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐ ___
Give & EC	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐ ___

Higher-Level Total: ☐☐

IBR Total: ☐☐

Bid to Caregiver ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ ___

Responding to Behavioral Requests

	1	5	10	15	20
Without Gesture					
Pass	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐ ___
Fail	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐ ___
With Gesture					
Pass	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐ ___
Fail	☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐ ___

% Correct: ___

RBR Total: ☐☐

Notes:

Initiating Social Interaction

Initiates Turn-Taking
Car ☐ *Ball* ☐ *Neither* ☐ Turn-Taking Score: ___

	1	5	10	15	20	Sum
Low-Level Tease	☐	☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐	___
High-Level Tease	☐	☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐	___

Tease Score: ___

ISI Total: ☐

Responding to Social Interaction

	1	5	10	15	20	
Social Interaction						
Eye Contact	☐	☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐	___
Act	☐	☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐	___
Appeal	☐	☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐	___
					Total:	___
Turn-Taking						
Car	☐	☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐	___
Ball	☐	☐☐☐☐	☐☐☐☐☐	☐☐☐☐☐	☐☐☐☐	___
					Total:	___

Response to Invitation
Comb ☐ *Hat* ☐ *Glasses* ☐ *None* ☐ Total: ___

RSI Total: ☐

Notes:

Language

Joint Attention
1 word ☐☐☐
2 words ☐☐☐

Behavioral Requests
1 word ☐☐☐
2 words ☐☐☐

Summary Scores

Recuperat de Mundy et al. (2003, p. 58-59)